

Greening Schoolyards

Impact on Children's Well-Being and Behavior,
Parental Support, and use for Outdoor Learning



Illustration by Lois van Dijk (six years)

Janke E. van Dijk-Wesselius

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GREENING SCHOOLYARDS

Impact on Children's Well-Being and Behavior, Parental Support, and use for Outdoor Learning

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Janke Elisabeth van Dijk-Wesselius

geboren te Smalingerland

promotoren: prof.dr. M. van Vugt
 prof.dr. A.E. van den Berg

copromotor: dr. J. Maas

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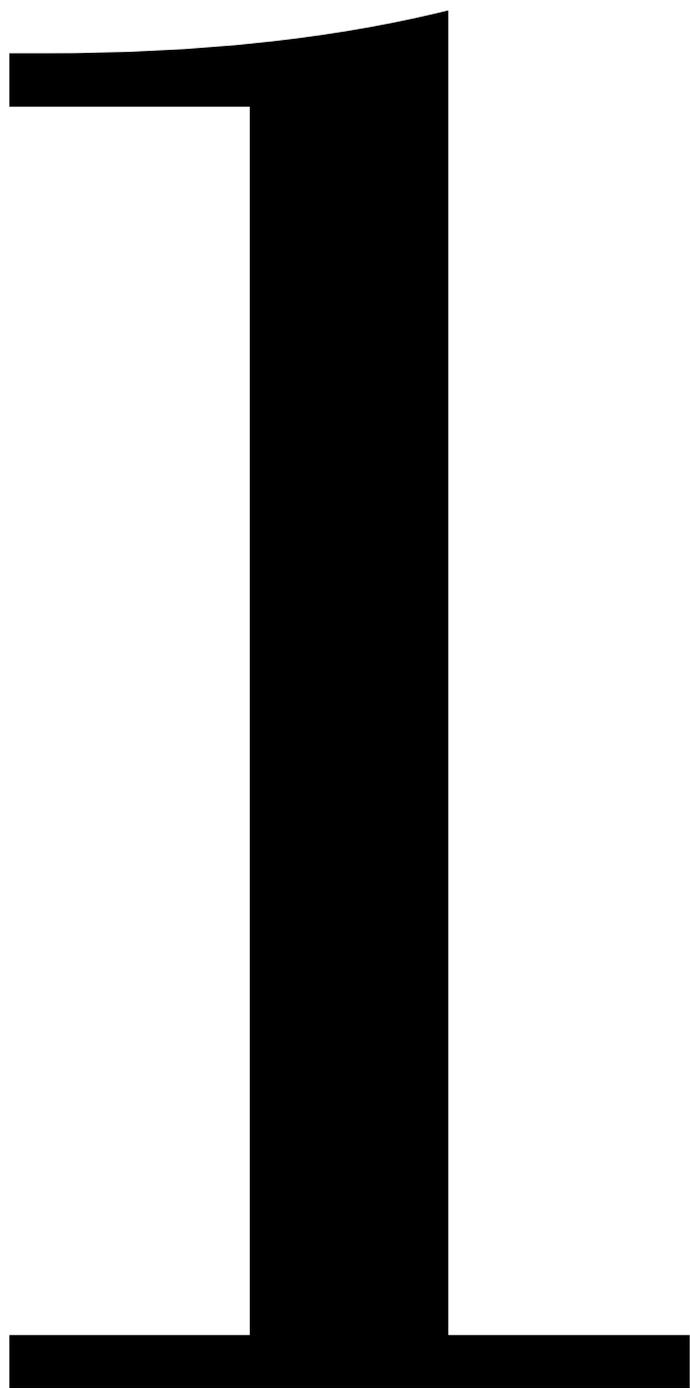
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Chapter 1

General Introduction

During my Ph.D., it never took me long to explain the general topic of my project: Greening schoolyards. At first, eyebrows were sometimes raised, in particular by people without children. However, a simple explanation of ‘re-design a schoolyard with natural features such as trees, shrubbery, flowers, grassy hills, sand and water’ often led to an anecdote of the person in question telling about him or her playing in nature during childhood. Discussing my work brought back memories of building huts, exploring forests, catching small insects, spending hours and hours outdoors, memories of freedom, memories of having fun. After listening to all these childhood experiences, I came to wonder: Why did we allow current generations of children to lose contact with nature?

Greening schoolyards

Around the globe, there is a growing concern regarding children’s loss of access to nature, and greening schoolyards is one of the initiatives to reconnect children with nature (Danks, 2010). This trend fits in a broader context of environmental awareness and urban sustainability. While the number of people inhabiting cities continues to expand, people are becoming increasingly aware of the risks for our health and well-being of this urban lifestyle. Greening our daily living environment has been proposed as one of the solutions to create healthy and sustainable cities (Douglas, Lennon, & Scott, 2017; WHO, 2017). Greening finds its way, amongst others, into communal gardens, workplaces, hospitals, and parks. In particular, for children, greening schoolyards could make a vital contribution to reconnecting every child with nature, regardless of their socioeconomic background (Andreas, 2018; Bates, Bohnert, & Gerstein, 2018). In the past few decades, the number of studies on the impact of greening schoolyards on schoolchildren’s well-being and healthy development has risen (Chawla & Nasar, 2015; Dadvand, Gascon, & Markevych, 2019). Still, much is left to uncover, not only

when it comes to the benefits of green schoolyards for children, but also in relation to the practical implementation in the educational practice.

Aim of the thesis and research questions

The aim of this thesis is to extend the empirical evidence base for greening schoolyards and to provide guidelines for the implementation of green schoolyards in teachers' practices and student education. To this end, the thesis examined the following research questions:

- (a) How does greening the schoolyard impact children's appreciation, and physical, cognitive, and social-emotional well-being?
- (b) How does greening schoolyards impact children's play behavior during recess?
- (c) How do parents perceive and evaluate green – as compared to paved - schoolyards?
- (d) How can teachers incorporate green schoolyards as outdoor learning environments?

Below, I will first discuss the concept of green schoolyards and play behavior, followed by a theoretical framework for understanding the benefits of nature. Next, I provide a summary of previous empirical work regarding the impact of greening schoolyards on children's well-being and play behavior, parental perspectives, and outdoor learning in green schoolyards. Finally, I introduce the green schoolyard project and give an overview of the current thesis.

Green schoolyards: A definition

“So you buy a bucket of green paint and then drop it on the schoolyard...?”. There is a serious question behind this ‘joke’ I often came across in the first year of my Ph.D. What defines a green schoolyard and, an even more elusive question, what defines nature? The present thesis defines a green schoolyard as an outdoor school environment where natural elements, such as trees, flowers, sand, water, shrubbery, hills, and bushes, are combined to create an appealing schoolyard that invites and encourages children to interact, play and learn in and with nature

(Bell & Dymont, 2008). In a broader definition of nature, this inherently defines a green schoolyard as cultivated nature (Cronon, 1995). Green schoolyards are designed with natural features but are, in its essence, shaped by human ideals and purposes. Although the meaning of nature can vary across people, cultures, and age groups, in this thesis, nature refers to all areas of green space that are accessible for children and allow children to interact with living and non-living natural features and phenomena.

A definition of play

A core purpose of a green schoolyard is to facilitate children to engage in meaningful play experiences during recess. The characteristics and definitions of play have been discussed widely in the literature (cf. Glenn, Knight, Holt, & Spence, 2013). As are the threats of current modern society to time and resources available for children to spend their time in play (Elkind, 2007; Gray, 2017). It is not the aim of the current thesis to find consensus on the definition of play and its position in our society. The current thesis defines play as the result of an ongoing interaction between a child and its environment. Invitations in the environment and the needs and abilities of a child together set the stage for play activities. Through play, children learn to adapt to the world and to adapt the world to themselves. In its essence, play is self-chosen, self-directed, and intrinsically motivated. It is guided by mental rules and imaginative (Gray, 2017). Previous work values in particular creative play forms (such as constructive and dramatic play behaviors) and exploratory play behavior (focused examination of objects in the environment) for their developmental value (Burriss & Tsao, 2002; Schulz, Standing, & Bonawitz, 2008). These child-initiated, exploratory, and free experiences are well-known to support children's physical, cognitive, and social-emotional development and well-being (Cole & Cole, 1989).

This definition implies the importance of designing school environments for children that invite and challenge children to experiment, explore, be inventive, gain experience, and

practice their skills. Ideally, schoolyards should provide opportunities for different types of play behavior and suit children's individual needs and abilities (Tranter & Malone, 2004; Wilson, 1997). However, traditional schoolyards are, in general, considered one-dimensional, non-responsive, and restricted in the forms of play behaviors they afford in children (Woolley & Lowe, 2013). Traditional, paved schoolyards, for instance, tend to appeal mostly to boys' interests, who dominate the schoolyard with competitive and rule-bound games (Sharma-Brymer & Bland, 2016). Also, artificial play equipment on traditional schoolyards can foster strained power relations based on children's physical competence, which can diminish possibilities for participation of all children (Dyment & O'Connell, 2013; Lucas & Dyment, 2010). The trend of greening schoolyards reconnects all children with natural features, and thereby creates a more multi-dimensional play environment that appeals to children's individual needs and interests, and fosters children's well-being and development.

The benefits of nature for children

The idea that contact with nature can foster the well-being and development of children is not new. In the early years of environmental psychology, several researchers have observed and documented the unique contribution of contact with nature to a child's life (see for a historic overview Chawla & Nasar, 2015). These observations highlight how in contact with nature, children's experiences easily become alive and how contact with nature fosters more creative, varied, and child-initiated play experiences (Hart, 1979; Kirkby, 1989). In contrast to a one-dimensional built environment, a natural environment is more responsive to a child's needs, abilities, and interests. Several theories can help to understand this responsiveness. First, according to the Affordance Theory (Gibson, 1979), the physical environment affords different actions and behaviors that correspond with an individuals' body size, strength, skills, fears, and other needs and abilities. For instance, a tree only affords climbing if a child can reach the

lowest branch or something is only grab-able if it fits in the hand of the child. As such, affordances can be defined as functionally significant properties of the environment that are delineated by the relationship between the environment and an individual. Heft (1988) elaborated Gibson's theory by proposing a taxonomy of affordances in children's environments, such as a "climb-on-able feature" or a "jump-over-able feature". Compared to most non-natural environments, natural environments tend to be more rich in the presence of affordances. This richness creates an inclusive play environment that speaks upon the individual needs, abilities and interests of children (Kyttä, 2004; Lucas & Dymont, 2010; Wilson, 1997).

The richness in invitations for play opportunities is further strengthened by the presence of loose parts, of materials that can be moved around, designed and re-designed. The Theory of Loose Parts (Nicholson, 1972) states that loose parts, like recycled materials and natural materials, are less set compared to ready-to-use (built) play equipment, like a climbing frame or a ball. Loose parts in an environment provide children with endless opportunities to engage in open and flexible play experiences. Natural environments tend to be rich in loose parts, like twigs, leaves, and sand, which create abundant opportunities for children to touch, smell, explore and modify natural features with their entire body (Engelen et al., 2017). Children love to interact with these kinds of natural features that capture and hold their attention and stimulate their senses (Chawla & Nasar, 2015; Dymont & O'Connell, 2013). The presence of loose parts in an environment draws children in a creative engagement with the environment in which they immediately experience consequences of their own and other children's actions. As such, loose parts, which are naturally present in nature, create numerous opportunities for children to engage in constructive, imaginative, and exploratory play behavior (Engelen et al., 2017). Loose parts and affordances together facilitate enriched play experiences that, for instance, foster children's physical activity, social interaction, cooperation, skill mastering and feelings

of self-resilience and competence (Chawla, Keena, Pevec, & Stanley, 2014; Dymont & Bell, 2007a).

The beneficial impact of contact with nature on children's physical, cognitive, and social-emotional well-being can be further explained by theories that find their origin in explaining nature's capacity to provide restoration from mental fatigue and stress. First, Attention Restoration Theory (ART; Kaplan, 1995) states that an unthreatening natural environment elicits a soft fascination which effortlessly and pleasantly attracts attention. This state allows depleted cognitive resources, for instance, as a consequence of prolonged paying attention in the classroom, to rest and restore. This could explain a positive impact of greening schoolyards on children's attentional capacity. Further, natural environments could support restoration by fostering a sense of being away and extent, and a greater sense of compatibility with an individuals' needs and purposes.

In a similar vein, Stress Recovery Theory (SRT; Ulrich, 1983; Ulrich et al., 1991) states that spending time in unthreatening natural environments can evoke an initial positive affective reaction which triggers a series of positive psychophysiological responses. This response could explain a positive impact of greening schoolyards on children's emotional well-being. Finally, the Biophilia Hypothesis (Kellert & Wilson, 1995) states that all human beings have a genetically determined need to affiliate and connect with life and life-like forms. Playing on a green schoolyard can fulfill this need, and thereby foster a sense of connectedness to nature. This connectedness stimulates increased feelings of psychological well-being and contributes to more pro-social behavior in children (Collado, Staats, & Corraliza, 2013).

The benefits of greening schoolyards

Together the theories offer a multidimensional framework of explanations as to why greening schoolyards could foster children's physical, cognitive, and social-emotional well-

being and development through an enriched (play) experience. An increasing body of empirical evidence supports these explanations.

First, previous observational and exploratory studies show that children prefer to play in natural areas at the schoolyard (Jansson, Gunnarsson, Mårtensson, & Andersson, 2014; Lucas & Dymont, 2010). Besides, studies show that children playing on a green schoolyard show greater appreciation of their schoolyard compared to a paved schoolyard (De Vries, Langers, Donders, Willeboer, & Van Den Berg, 2013; Maas, Tauritz, van der Wal, & Hovinga, 2013; Samborski, 2010).

Second, several studies support the claim that green schoolyards create opportunities for children to behave more physically active (Ferguson, Cassells, MacAllister, & Evans, 2013; Fjørtoft, 2004; Sharma-Brymer & Bland, 2016). However, the evidence up to date is somewhat mixed and inconclusive, as not all studies support the assumption of increased physical activity in green areas (Mårtensson et al., 2014). This could be partly explained by the fact that open and flat spaces promote locomotion at high speed, in particular in boys, while green areas foster intensive activities like climbing and balancing (Fjørtoft, Kristoffersen, & Sageie, 2009b).

Third, a few studies regarding the restorative qualities of green schoolyards suggest that playing on a green schoolyard enables children to escape from stress (Bagot, Allen, & Toukhsati, 2015; Chawla et al., 2014) and supports building social relationships (De Vries et al., 2013; Maas et al., 2013). Still, the evidence regarding the impact of greening schoolyards on other restorative dimensions such as children's attentional capacity and social-emotional well-being is relatively scarce.

Fourth, there are strong indications that greening schoolyards promotes a wider variety of children's play behavior. However, there is still a need for more direct empirical evidence from systematic observational studies. Previous ethnographic and cross-sectional studies, in particular, suggest that green schoolyards can stimulate more creative, exploratory, and

constructive play behavior (Dyment & Bell, 2007a; Malone & Tranter, 2003; Ozer, 2007; Samborski, 2010). Furthermore, green schoolyards are supposed to appeal to a wider variety of children's interests and to be more inclusive for the needs of both boys and girls (Dyment & Bell, 2008; Lucas & Dyment, 2010; Mårtensson et al., 2014).

While a growing body of studies supports a positive impact of greening schoolyards on children's well-being and play behavior, the available evidence is still limited and, in some cases, mixed or inconclusive. Moreover, most studies suffer from limitations such as lack of pre-measurements or control groups. Further, up to date, there are also no longitudinal studies that have measured the more long-term impact of greening schoolyards. To this aim, chapters two and three from this thesis aim to extend the empirical evidence regarding the impact of greening schoolyards on children's well-being (chapter two) and play behavior (chapter three).

Parental perspectives on green schoolyards

Despite the potential benefits of green schoolyards, schools often struggle with parental support and collaboration (Redman, 2013). While several studies show that parental support can be an essential facilitator of a successful implementation of a green schoolyard (Maas, Muller, & Hovinga, 2014; Redman, 2013), we know little about how parents view the green schoolyard and how they wish to be involved. This lack of knowledge may lead to ineffective attempts of schools to inform and involve parents (Hornby & Lafaele, 2011; Pushor & Amendt, 2018). To this aim, chapter four focuses on gaining insight into parental perspectives on green schoolyards.

Outdoor learning in green schoolyards

Whereas chapter two and three address the impact of greening schoolyards on children, and chapter four concerns the perspective of parents, chapter five enunciates the perspective of teachers. This chapter takes a more formal approach to the green schoolyard as a learning

environment through outdoor learning activities facilitated by teachers. Given the enriched environment, green schoolyards afford a meaningful context for learning, as they provide children with numerous opportunities to handle, touch, smell, explore and modify natural features with their entire body (Auer, 2008; Ballantyne & Packer, 2009). Through these embodied learning experiences learning easily becomes alive (Lieberman & Hoody, 1998). Opportunities arise for children to learn regular classes in subjects such as reading, writing, mathematics, sciences, art, drama, and environmental education beyond the borders of their classroom (Barfod, Ejbye-Ernst, Mygind, & Bentsen, 2016; Dymont, 2005).

Although several studies support the potential of green schoolyards as outdoor learning environments (Blair, 2009; Rickinson et al., 2004; Wistoft, 2013), outdoor learning remains mostly unrealized in current educational practices. A few studies suggest barriers that hinder teachers from realizing outdoor learning activities in the green schoolyard. These are, for instance, unfamiliarity with outdoor learning, lack of confidence in their outdoor teaching expertise, work pressure, and lack of time (Dymont, 2005; Maynard & Waters, 2007; Skamp & Bergmann, 2001). Previous studies also suggest that current curricula do not endorse outdoor learning and that outdoor teaching challenges teachers to discover the pedagogical opportunities of green schoolyards (Dymont & Reid, 2005; Passy, 2014; Waite, 2011). However, thus far, no study has actively addressed how teachers can overcome these barriers and realize the potential of green schoolyards as learning environments in their educational practice.

The Green Schoolyard project

The data presented in this thesis are part of a four-year research program on greening schoolyards of primary schools in The Netherlands. The project was a collaboration between Universities, Applied Universities, and organizations in the field. In the project, researchers, teachers, professionals, and students collaborated to add the empirical evidence base for

greening schoolyards and support the direct implementation of findings in teachers' practices and student education. The overall design of the project consists of two distinct trajectories:

- (1) A quantitative trajectory consisting of a prospective intervention study with a two-year follow-up to investigate the impact of greening schoolyards on children's aged 7 to 11 well-being and play behavior, and a survey among parents to gain more insight in parental perspectives on benefits of green schoolyards and their willingness to become involved.
- (2) A qualitative trajectory consisting of a collaborative action research trajectory called 'becoming an outdoor teacher' aimed to gain insight in barriers and solutions teachers experience while they experiment with outdoor learning in their green schoolyard.

The intervention study follows up on the current need in the literature for more controlled, longitudinal quasi-experimental studies regarding the impact of greening schoolyards on children's well-being and play behavior. For this study we collected a wide range of data including accelero-based measurements of physical activity, video observations of play behavior, scores on tests for attention and social orientation, and self-reports of children's appreciation of the schoolyard, and their social and emotional well-being. Data collection took place at nine schools in The Netherlands for three consecutive years (2014, 2015, 2016) in the period between February and June. At the baseline measurement in 2014, all nine schools had a paved schoolyard. Five schools greened their schoolyard between pre-measurement and first follow-up in 2015. The other four schools served as control schools and did not green their schoolyards. The paved schoolyards were mostly covered with tiles and contained some play equipment made of non-natural materials, like swings or climbing frames. All intervention schools greened certain areas of their schoolyards, and also kept some areas paved. The green areas covert mostly features as grassy hills, bushes, trees, tunnels made of tree branches, loose

tree branches, and garden-like parts. Images of the schoolyard and detailed description of the designs of these schoolyards can be found in chapters 2 and 3.

The first trajectory also included a survey among parents of both the control and the intervention schools. The survey asked parents about their appreciation of the schoolyard, children's behavior in the schoolyard, (dis)advantages of a green schoolyard, and willingness to become involved.

The second trajectory covered a period of three years in which teachers, researchers, and professionals worked together to investigate how teachers can integrate the green schoolyard as a learning environment in a schools' curriculum. In this collaborative action research, teachers of five primary schools in The Netherlands were followed, in two cohorts, for two consecutive years while they participated in meetings aimed to familiarize with outdoor learning. Across schools, a total of 20 meetings were organized and 75 teachers participated in the project. From the five primary schools that took part in the project, one also participated in the first trajectory. Based on their experiences in this project, teachers identified barriers when integrating the green schoolyard as a learning environment and found practice-based solutions to overcome these barriers.

Outline of the thesis

The present thesis consists of four empirical chapters that discuss the potential of green schoolyards to support children's well-being through informal and formal play and learning experiences. Chapter two provides insights into the impact of greening schoolyards on primary schoolchildren's appreciation of the schoolyard, physical activity, attentional capacity, and social-emotional well-being, using data from both the intervention and the control schools who participated in the green schoolyard project. Chapter three examines children's play behavior during recess before and after greening the schoolyard using video data from the five

intervention schools. Chapter four discusses parental perspectives on green schoolyards and parents' willingness to be involved, using survey data from parents from control and intervention schools who participated in trajectory one as well as data from a different survey among parents from other schools with paved and green schoolyards. Chapter five addresses how teachers can overcome barriers and find solutions to realize outdoor learning in green schoolyards, using data from teachers of one intervention school and four other schools with green schoolyards. The thesis concludes with a general discussion (Chapter 6) in which the main findings are summarized and methodological issues and practical implications are discussed along with recommendations for future research.



Chapter 2

The Impact of Greening Schoolyards on the Appreciation, and Physical, Cognitive and Social-Emotional Well-being of Schoolchildren: A Prospective Intervention Study

This chapter is based on van Dijk-Wesselius, J. E., Maas, J., Hovinga, D.,
Van Vugt, M., & Van den Berg, A. E. (2018).

The impact of greening schoolyards on the appreciation, and physical, cognitive
and social-emotional well-being of schoolchildren: A prospective intervention
study. *Landscape and Urban Planning*, 180, 15-26.

Abstract

Greening schoolyards is an initiative to reconnect children with nature and afford meaningful experiences that foster children's well-being. To strengthen the empirical basis for greening schoolyards, we conducted a longitudinal prospective intervention study with a two-year follow-up, to investigate the impact of greening schoolyards on schoolchildren's (age 7-11) appreciation of the schoolyard, and their physical, cognitive, and social-emotional well-being. Data were collected amongst nine elementary schools in moderate-to-high-urbanized areas in The Netherlands with approximately 700 children at each measurement. At baseline, all nine schoolyards were paved. Five schools greened their schoolyard between baseline and first-follow-up. Objective measurements included accelero-based measurements of physical activity during recess, attentional tests (Sky Search Task, Manly et al., 2001; Digit Letter Substitution Test, Natu & Agarwal, 1995) and a social orientation test (Social Orientation Choice Card, Knight, 1981). Self-report questionnaires included children's appreciation of the schoolyard (naturalness, likability, attractiveness and perceived restoration), and their social- and emotional well-being (Strength and Difficulties Questionnaire, van Widenfelt, Goedhart, Treffers & Goodman, 2003 ; Social Support, RIVM, 2005 ; Pediatric Quality of Life Inventory, Varni, Seid & Kurtin, 2001). Multilevel data analyses support our expectation that greening has a positive impact on children's appreciation of the schoolyard, their attentional restoration after recess and social well-being. Furthermore, our results indicate that greening stimulates physical activity of girls. We found no impact on emotional well-being. These findings provide some support for the relevance of greening schoolyards and may guide further development of schoolyards that facilitate the well-being of schoolchildren.

Keywords: Nature and health, green schoolyards, child development, restoration, green design

Children need experiences to wonder, explore, give meaning, take risks, feel comfortable, be challenged and physically modify the world around them. These sensory-motor experiences are well-known to support children's physical, cognitive and social-emotional development and well-being (Cole & Cole, 1989). An increasing body of evidence suggests that green spaces, like gardens, parks, woods and beaches, are essential elements of healthy communities for children to immerse in these experiences (for reviews, see Chawla & Nasar, 2015 ; Gill, 2014).

While evidence for the importance of nearby green spaces in children's everyday lives is growing, opportunities for children to engage with natural environments continue to decrease (Ferguson et al., 2013; WHO, 2017). Concerned by this loss of access to green space, organizations and professionals world-wide have highlighted the importance of reconnecting children with nature to promote healthy, sustainable and livable cities (Douglas et al., 2017; WHO, 2017). One way to reconnect children with nature is through greening their schoolyards. Given that elementary schoolchildren, aged 7 to 11, on average spent most of their time at school, greening schoolyards could make an important contribution to their physical, cognitive and social-emotional development and well-being (Chawla & Nasar, 2015).

The case for greening schoolyards

In line with Bell and Dymont (2008) we describe a green schoolyard as an outdoor school environment where natural elements (such as trees, flowers, sand, water, grass, hills and bushes) are combined to create a more appealing schoolyard and improve the quality of children's (play) experiences. Ideally, a green schoolyard should be designed and used in such a way that it invites and encourages each child to interact, play and learn in and with nature in ways that fosters all aspects of their development and well-being.

Several theories provide guidance for understanding the potential benefits of greening schoolyards on children's development and well-being. First, according to the widely noted biophilia hypothesis (Kellert & Wilson, 1995), all human beings have a genetically inherited need to affiliate and connect with life and life-like forms. Playing on a green schoolyard can fulfil this need, and thereby foster a sense of connectedness to nature which induces increased feelings of psychological well-being. Connectedness to nature has also been linked to more pro-social behavior in children (Collado et al., 2013). Other theories focus on nature's capacity to provide restoration from stress and mental fatigue, to explain the impact of greening schoolyards on children's cognitive and emotional well-being. More specifically, Stress Recovery Theory (SRT; Ulrich, 1983) states that exposure to unthreatening natural environments elicits an initial positive affective reaction which triggers a series of positive psychophysiological responses. In a related vein, Attention Restoration Theory (ART; Kaplan, 1995) posits that unthreatening natural environments automatically draw attention in a pleasant and involuntary way, which allows depleted cognitive resources to rest and replenish and could explain a positive impact of greening schoolyards on children's attention restoration. Natural environments may further support cognitive restoration by fostering a sense of being away and extent, and because their characteristics tend to be compatible with users' needs and purposes.

According to another line of reasoning, children's (play)experiences in a natural environment are the central pathway to understand how engagement with nature fosters children's well-being. For instance, the Theory of Loose Parts (Nicholson, 1972) attributes the beneficial effects of nature to the presence of loose parts, or materials that can be moved around, designed and re-designed, like twigs, stones and sand. These loose parts create abundant opportunities for children to engage in open and flexible play experiences. Children are drawn in a creative engagement with the environment in which they experience immediate consequences of their own and other children's actions. As a result, in children's behavior there

is an endless stream of transforming, exploring and modifying the environment with all their senses and abilities, and an ongoing interaction with the behavior and abilities of children surrounding them. (Chawla et al., 2014). In a similar vein, Affordance Theory (Gibson, 1979) posits that there is an intertwined relation between people and the environment, in which affordances, the functions environmental objects can provide to people, are related to the individuals themselves. Natural settings tend to offer a rich variety of affordances, or perceived opportunities for play that tap into the child's current needs, interest and abilities. For example, a tree with low-lying branches invites children to immediately climb it, when they at least can reach the lowest branch.

Loose parts and affordances facilitate an enriched play situation through which nature fosters children's cognitive, social and emotional well-being and development by the behavior of children in these environments. Natural features are less set, children can derive their own meanings and are invited, challenged and encouraged to explore the world and their own and other children's abilities. These experiences, for instance, stimulate children's physical activity, social interaction, cooperation, skill mastering and feelings of self-resilience and competence. (Chawla et al., 2014; Dymont & Bell, 2007a).

Together these theories propose an integrated framework of affective, cognitive and behavioral explanations on why greening schoolyards could foster children's physical, cognitive and social-emotional well-being. Below, we discuss empirical evidence supporting these explanations.

Appreciation of the schoolyard

Several observational and explorative studies show that schoolchildren prefer to play in natural areas at the schoolyard (Chawla et al., 2014; Jansson et al., 2014; Lucas & Dymont, 2010), and that children playing on a green schoolyard show greater appreciation of their

schoolyard compared to a paved schoolyard (Maas et al., 2013; Samborski, 2010). Furthermore, a Dutch study followed 308 children aged 6 to 9 of four elementary schools before and after greening and found that on two schools children's appreciation of the schoolyard increased after greening. In addition, they found that appreciation was positively related to attentional capacity, and social-and emotional well-being (De Vries et al., 2013).

Physical activity

Although the evidence is somewhat mixed and inconclusive, the idea that that greening schoolyards can support children's physical activity is supported by several studies (Ferguson et al., 2013; Sharma-Brymer & Bland, 2016). For instance, 105 teachers, parents and administrators of 59 Canadian elementary schools consistently reported that greening their schoolyard created opportunities for children to be more physically active (Bell & Dymont, 2008). Furthermore, (Fjørtoft, 2004) showed that playing on a green schoolyard every day for one or two hours led to significant improvement of motor ability in children aged 5-7 in Norway, compared to children who played on a traditional schoolyard. However, other studies do not support the assumption of increased physical activity in green areas. For instance, Mårtensson et al. (2014) showed that although environments with more diverse features support a greater variety in play experiences, schoolchildren aged 10-13 on two schools in Sweden, were not more physically active on green schoolyards compared to paved schoolyards. This may be explained by the fact that paved open spaces and flat surfaces promote and invite locomotion in high speed – which may even result in higher level of physical activity compared to natural spaces, especially in boys (Fjørtoft, Kristoffersen, & Sageie, 2009a).

Cognitive and social-emotional well-being

Empirical research on the impact of greening schoolyards on attentional capacity and social-emotional well-being of children is relatively scarce. One study among 14 elementary schools in a large Australian city showed that children's perceptions of the restorative qualities of their schoolyard were positively related to vegetation volume and self-reported positive affect (Bagot et al., 2015). Furthermore, based on parent and teacher's observations, alumni memories and ethnographic observations, Chawla et al. (2014) report that playing on a green schoolyard enables children aged 6-12 to escape from stress and supports social relationships. Furthermore, two Dutch studies showed that children playing on a green schoolyard reported that they had more friends and experienced less bullying behavior than children playing on a paved schoolyard (De Vries et al., 2013; Maas et al., 2013).

The available empirical knowledge partly supports the theoretical framework that greening schoolyards indeed provides opportunities for children to immerse in meaningful play experiences, and that these experiences can positively influence children's appreciation of the school ground, their physical activity, and cognitive, and social-emotional well-being. However, the available empirical evidence for schoolchildren is still limited and in some cases mixed or inconclusive. Moreover, most of the studies suffer from limitations such as a lack of pre-measurements or control groups. As yet, there are also no longitudinal studies that have measured the more long-term effects of greening schoolyards.

The present research and hypotheses

We conducted a prospective intervention study with a two-year follow-up to further understand the impacts of greening schoolyards on the well-being of schoolchildren. In particular we focus on the impacts of greening on children's physical, cognitive, and social-emotional well-being. We hypothesized that at first and second follow-up, after their schoolyard

had been greened, children at the intervention schools display (1) more positive appreciation of the schoolyard (2) increased levels of physical activity during recess (3) more attentional restoration after recess, and (4), improved (pro)social behavior and (5) better emotional functioning. While these effects were expected for all children, we also explored moderating influences gender (in particular for physical activity, see (Fjørtoft et al., 2009a)) and grade level.

Method

Overview and design

The data presented in this paper are part of a large, four-year research program on greening schoolyards of elementary schools in moderate-to-high-urbanized areas in The Netherlands (Wesselius, Maas, & Hovinga, 2015). Data collection took place at nine schools during three consecutive years (2014, 2015, 2016) in the period between February and June. At the baseline measurement in 2014 the schoolyards of all nine schools were paved. Five schools greened their schoolyard between pre-measurement and first follow-up in 2015. The other four schools served as control schools and did not green their schoolyards. Data collection covered a broad set of objective and self-reported measurements. Objective measurements included video observations of children's play behavior and accelerometer-based physical activity measurements at the schoolyard, classroom-based tests of children's attentional capacity and social value orientation. Self-report questionnaires were used to assess, among other things, children's perceptions of the schoolyard, and their social and emotional well-being. In addition, we collected questionnaires amongst parents and teachers, and held interviews with principals of the participating elementary schools. The current paper discusses results from the accelerometer data and classroom-based tests and questionnaires. Results of the video observations and parent- and teacher evaluations, as well as data gathered at a tenth school which already had a green schoolyard at baseline, will be reported elsewhere.

Schools

Participating schools were selected based on various inclusion criteria. A main selection criterion for the intervention schools was that they should have advanced plans for greening their schoolyards between 2014 and 2015, according to guidelines for greening schoolyards developed by Fonds1818, a Dutch foundation which has subsidized greening of 187 schoolyards in the Western part of the Netherlands (Fonds1818, 2014). Second criterion was that the schools should be located in urbanized areas with limited green play opportunities for children. Consequently, only schools in extremely high urbanized (> 2500 addresses per square kilometer, one intervention school), highly urbanized (1500 to 2500 addresses per square kilometer, two intervention schools) and moderately urbanized areas (1000 to 1500 addresses per square kilometer, two intervention schools) were included in the study. Finally, four control schools were selected to match the intervention schools with respect to their level of urbanization of the neighborhood and socioeconomic status of parents. School boards of schools that were potentially eligible for inclusion based on available data were approached directly by the research team or through the foundation for greening schoolyards. Of the 16 schools that were approached, seven declined to participate, mainly for lack of time or for not being sure that the greening could be completed within the specific period between 2014 and 2015.

The schoolyards: paved and greened

Paved schoolyards were mostly covered with tiles and contained some play equipment made of non-natural materials, like swings or climbing frames (Figure 1). When vegetation was present, this served only as a fence or decoration. The greening of the five schoolyards between baseline and first follow-up, was a tailored process supported by funding from Fonds1818. This funding was allocated based on the design, quality, shape and functionality of the schoolyard

greening which schools had to describe in a detailed plan. When this plan was approved, the greening was carried out in a participatory process with input from parents, teachers, children and designers.

Figure 2 gives an impression of each schoolyard of the intervention schools before and after the greening process. All intervention schools greened areas of their schoolyard and also kept some areas paved. The green areas cover mostly features as grassy hills, bushes, tree, tunnels made of tree branches, loose tree branches and garden-like parts.



School A



School B



School C



School D

Figure 1 Impressions of the paved schoolyards of the four control schools.



School E: Baseline



School E: After greening



School F: Baseline



School F: After greening



School G: Baseline



School G: After greening



School H: Baseline



School H: After greening



School I: Baseline



School I: After greening

Figure 2 Impressions of the schoolyards of the five intervention schools before greening at baseline (left) and after greening at second follow-up (right).

Participants

After excluding children who were absent due to illness, uncompleted tasks or other circumstances, the total study population consisted of 2031 children, aged seven to eleven in group 4, 5 and 6 (as classified by the Dutch educational system). Table 1 provides a summary of characteristics of children at each time of measurement at the intervention and control schools. Depending on the group they were in at the start of the study in 2014, children participated at all three measurements (N=238), at baseline and first-follow-up (N=233), or at first and second follow-up (N=201). The remaining of the children participated only at one measurement. The Research Ethics Committee of the faculty of Behavioural and Movement Sciences from the Vrije Universiteit approved the study and affirmed that the study would not induce negative consequences above minimal risk for the participating children. The study and study protocol were also approved by the school boards. Furthermore, a passive consent procedure was conducted by sending a letter to the children's parents in which the aim of the study was explained and in which parents were informed how they could withdraw their child from participation.

Table 1: Characteristics of children at each time of measurement at the intervention and control schools who participated in the classroom-based tests and questionnaires.

	Baseline (N=706)		First follow-up (N=682)		Second follow-up (N=643)	
	Intervention (N=351)	Control (N=355)	Intervention (N=360)	Control (N=322)	Intervention (N=331)	Control (N=312)
Total	49.7%	50.3%	52.8%	47.2%	51.5%	48.5%
Grade 4	121 (34.5%)	122 (34.4%)	116 (32.2%)	93 (28.9%)	106 (32.0%)	93 (29.8%)
Grade 5	125 (35.6%)	109 (30.7%)	117 (32.5%)	121 (37.6%)	106 (32.0%)	95 (30.4%)
Grade 6	105 (29.9%)	124 (34.9%)	127 (35.3%)	108 (33.5%)	119 (36.0%)	124 (39.7%)
% Boys	170 (48.6%)	181 (52.0%)	161 (44.7%)	168 (52.2%)	159 (48.0%)	175 (56.1%)
Age (in years)	8.5 (1.0)	8.6 (1.0)	8.6 (0.95)	8.6 (1.0)	8.6 (1.0)	8.7 (1.0)

Note. Children in cells with similar shading represent cohorts that participated in two or more times of measurement.

Measurements

All research materials were tested prior to the baseline measurement at the first school. Based on the outcomes of these tests, some of the materials were adapted to better match the children's knowledge and abilities. Due to these adaptations, the first school is not included in both attention tasks, Social Orientation Choice Card, perceived naturalness of the school ground, and self-reported emotional functioning. At each time of measurement, the same set of objective and self-reported measurements was administrated. All self-reported measurements were designed in a child friendly manner, with colorful illustrations and easy-to-answer options, and so that they can be filled in or administered as a classroom activity. Part of the materials have also been used in a study on the impact of green walls in classrooms (Van Den Berg, Wesselius, Maas, & Tanja-Dijkstra, 2017).

Appreciation of the schoolyard

Children answered several questions to assess their appreciation of the schoolyard. First, children evaluated the *naturalness* of their schoolyard on a 5-point likert scale from 1 'not natural at all' to 5 'very natural'. The concept of 'naturalness' was explained as 'We would like to know whether you think your schoolyard is a natural environment with natural features, such as grass, trees, flowers, bushes, water, sand and animals', at the start of the test session, to assure that all children would interpret the concept unambiguously. Second, children rated the *likability* of their schoolyard with on a scale from 1 'I don't like my schoolyard at all' to 10 'My schoolyard is fantastic, it could not be better'. Third, children judged the *attractiveness* of the schoolyard. Eight positive and eight negative words were paired and placed as each other's opposites. The items were presented as a five point scale, for example '1= very boring, 2 = a bit boring, 3 both as boring as adventurous, 4 = a bit adventurous, 5 = very adventurous'. Responses were combined into one average score, where higher scores indicate a more attractive schoolyard. The scale showed good reliability at all measurement times, with Cronbach's alpha ranging between .87 and .88. Lastly, children indicated their *perceived restorative quality* of the schoolyard on eight items derived from the Perceived Restorative Components Scale for Children (Bagot, 2004). Items were selected and amended to Dutch in collaboration with teachers. Children rated each item such as 'At the schoolyard I think about other things, not about learning in the classroom' and 'At the schoolyard I am free to choose my own activities' and 'At the schoolyard there are lots of things to discover' on a four point scale with '1= not true, 2 = somewhat true, 3 = true, 4 = completely true'. Factor analysis confirmed a unidimensional scale (45.1% explained variance), so responses were combined into an average score, where higher scores indicate higher perceived restorative quality. The scale showed good reliability on all measurement times, with Cronbach's alpha ranging between .81 and .82.

Physical activity in the schoolyard

Physical activity in the schoolyard during morning recess was objectively measured with *accelerometers* (model ActiGraph GT3X). During morning recess children played at the schoolyard for approximately 15 minutes. At each school in each group ten children were randomly selected to wear an accelerometer during recess. After excluding children due to malware, technical problems and other circumstances, a total of 731 measurements were included in the dataset (237 at baseline, 246 at first follow-up, and 248 at second follow-up).

Activity levels were quantified by measuring change in velocity over time, within a chosen sampling interval of 15 seconds. This small interval fits the short, intermittent way in which children commonly perform physical activities (Trost, McIver, & Pate, 2005). To ascertain that activity levels of children would not be influenced by prior beliefs, no information was given about the true reason of wearing an accelerometer. Instead, children were told that the researchers wanted to see how they played on their schoolyard. Accelerometer activity counts were transformed into categories of minutes spent in sedentary (count cut-off ≥ 0 per 15 s), light (count cut-off ≥ 26 per 15 s), moderate (count cut-off ≥ 574 per 15 s) or vigorous (count cut-off ≥ 1003 per 15 s) physical activity intensity during recess with help of the data analysis program ActiLife (Version 6.13.1). Specific cut-offs for time spend in each category were chosen based on the study of Evenson, Catellier, Gill, Ondrak, and McMurray (2008). The cut-off points used in this study have been found to predict activity intensity within each category in children best (Trost, Loprinzi, Moore, & Pfeiffer, 2011). For this study time spent at moderate and vigorous physical activity (MVPA) levels was summed, because time spent on a MVPA level, preferably for 60-minutes a day, is believed to be beneficial for children's health (WHO, 2015). The amount of MVPA in minutes was divided by total recess time to provide a percentage of MVPA during recess on a continuous scale.

Attention restoration

Two attentional tests were administered before and after recess: the ***Digit Letter Substitution Test (DLST)*** to measure information processing speed (Natu & Agarwal, 1995) and the ***Sky Search task (SST)***, a subscale from the Test of Everyday Attention for Children, to measure selective attention (Manly et al., 2001). First, the DLST required children within 90 seconds to convert as many randomly ordered digits (1 to 9) as possible to letters according to a key that assigns a letter to each number. Attention restoration on the DLST was calculated as the difference between the total number of digits converted before and after recess, where a higher improvement score indicates better restoration of information processing speed. The DLST has shown good test-retest reliability, $r = .97$, as well as convergent validity with other established attentional tests, $r = .40$ (Pradhan, 2013). Second, the SST consists of an A4 sheet with rows of figures depicting pairs of different and pairs of identical space crafts (twins). Children were required to underline as many pairs of identical space crafts in 45seconds. Attention restoration on the SST was calculated as the difference between the total correctly underlined identical pairs before and after recess, where a higher improvement score indicates better restoration of selective attention. The SST has shown good test-retest reliability, $r = .90$, as well as convergent validity with other established attentional tests, $r > .40$ (Manly et al., 2001). To reduce learning effects, at each measurement occasion two different variants of the DLST and SST were used before and after recess, and counterbalanced between children. For the DLST, different versions were constructed at the three measurement times, using the same digits but different letters. All analyses are controlled and adjusted for version effects.

Pro-social orientation

The Social Orientation Choice Card (SOCC; (Knight, 1981)) was administered after morning recess to assess children's ***prosocial orientation***. Children were told that they would

receive gifts in the afternoon and that the size of their gifts would be based on the amount of points they collected during the game. Besides collecting points for themselves, they would also collect points for another child. The size of the gifts this child received, would also be based on the amount of points that they collected during the game. We instructed that they would not get to know who this child was, not during and not after playing the game. In six turns children chose between three alternatives to divide points between themselves and the other child. The alternatives were all constructed according to the triple dominance scale: prosocial – individualistic – competitive. Children were categorized as prosocial when they chose the prosocial alternative for at least four out of six turns, and as not prosocial when they chose the individualistic or the competitive alternative at least four out of six times. Children that did not fall in these two categories were labelled ambiguous and were excluded from further analysis (23.1% at baseline, 23.2% at first follow-up, 27.7% at second follow-up).

Self-reported social behavior

Social behavior at school was assessed with the subscale *peer problems* (three items, for example ‘Other children bully me at school’) and *prosocial behavior* (four items, for example ‘I easily share things such as candy, toys and pencils with other children at school’) from the validated Dutch version of the Strength and Difficulties Questionnaire (Van Widenfelt et al., 2003) and the subscale *social support in friendships* (six items, for example ‘My friends at school and I help each other’) from a validated Dutch instrument for assessing schoolchildren’s social functioning (RIVM, 2005). Children rated the items on a four point scale with ‘0 = not true, 1 = somewhat true, 2 = true, 3 = completely true’. Responses were combined into an average score for each subscale, with higher scores indicating less peer problems, more prosocial behavior and more social support. On all measurement times, the subscales peer problems and prosocial behavior showed acceptable reliability with Cronbach’s

Alpha ranging between .64 and .70 for peer problems and between .66 and .72 for prosocial behavior. The subscale social support showed good reliability with Cronbach's Alpha ranging between .77 and .82.

Emotional functioning

Children indicated their self-perceived emotional functioning on the subscale ***emotional functioning*** of the Pediatric Quality of life scale (Varni et al., 2001), which has found to be a reliable measure to assess quality of life in Dutch Children (Engelen, Haentjens, Detmar, Koopman, & Grootenhuis, 2009). In the classroom one by one five emotional problems were explained by the experimenter, for example 'I worry about what will happen to me', and children indicated to what extent they experienced difficulties with that problem on a five point scale with '1 = never, 2 = almost never, 3 = sometimes, 4 = often, 5 = almost always'. Each answer was reversed and combined an average score with 5 representing the best emotional functioning. The scale showed sufficient reliability on all measurement times, with Cronbach's Alpha ranging between .64 and .71.

Procedure

Each participating elementary school was visited for one school day at baseline and at both follow-ups. The chosen weekdays and sequence of visitation were equal for baseline and follow-up measurements. The research team visiting the schools consisted of three researchers, accompanied by ten students (teacher training, psychology, health sciences students). Prior to data collection, students were trained to ensure an adequate understanding of the method of data collection. A data collection protocol was developed to minimize nuisance due to differences in data collection and therewith increase the reliability and validity of the findings. Within this

protocol, information about the order and execution of measuring and accompanying instructions were described.

Data analysis

Data were analyzed using MLwiN software for multilevel analysis to control for the (partial) clustering of measurements within children (repeated measures) and the clustering of children within schools. We estimated the effects of greening the schoolyard using a basic three-level model where time was nested within children, and children were nested within schools. Furthermore, all analyses were controlled for group and gender and in case of moderating effects analyzed separately for each grade level and gender. First, intercept-only models were fitted with separate random intercepts for the three times of measurements at child and at school level. Second, gender and group were added as covariates. Third, we estimated the main effect of time by adding the follow-up measurements to the model with baseline as reference category, and specified random coefficients for each time of measurement at the child level. Next, the main effect of condition (intervention vs control) was estimated. Lastly, effects of greening of the schoolyards at first and second follow-up were estimated by specifying interaction-terms between the follow-up measurements (time) and condition. During each step overall effects as well as individual effects of the parameters were estimated. In addition, we checked for moderating effects of gender and group by adding 2 and 3-way interaction terms of gender/grade level with condition and time.

Results

Table 2 provides an overview of unadjusted mean values for all outcome measures. Table 3 gives a summary of overall as well as individual main effects of condition and time, and interaction effects between time and condition.

Appreciation of the schoolyard

There were no baseline differences between the control and intervention schools in perceived naturalness, perceived attractiveness and perceived restorative quality of the schoolyard, $ps > .3$. However, children in the intervention condition gave a significant lower average likability score to their paved schoolyard than children in the control condition, mean adjusted difference = -0.62, 95 % CI [-1.22, -0.017], $p < .05$. $ps > 8$. Across the two follow-up measurements, there were significant main effects of time and condition for naturalness, attractiveness and likability, with scores at follow-up being generally higher than scores at baseline, and scores in the intervention conditions higher than in the control conditions. These main effects were qualified by significant interactions between time and condition. As illustrated in Figure 3, at first and second follow-up children in the intervention condition perceived their schoolyard as more natural, gave a higher likability score and perceived it to be a bit more attractive, compared to baseline. By contrast, scores of children in the control condition remained approximately the same across times of measurements. Furthermore, the baseline difference between control and intervention schools in averaged perceived likability was no longer present at both follow-up measurements, $ps > .2$. Greening the schoolyard did not affect the perceived restorative quality of the schoolyard, $ps > .2$, nor were there any significant main effects of condition or time on perceived restorative quality, $ps > .1$.

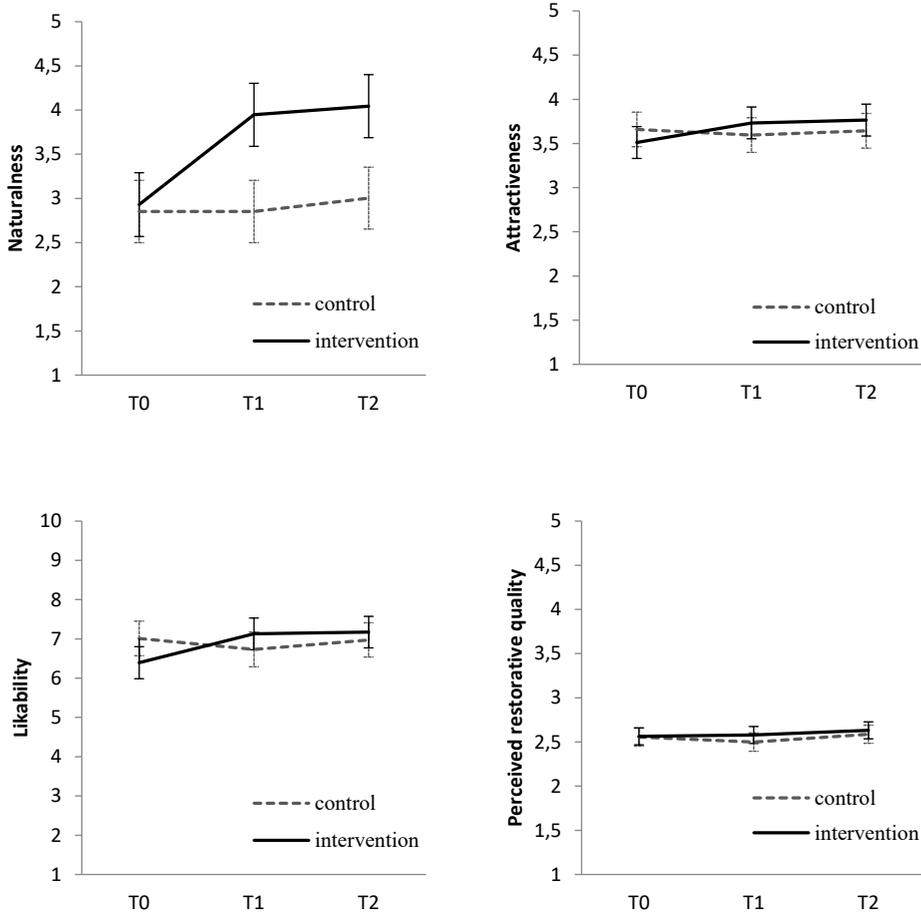


Figure 3. Scores on the Naturalness, Attractiveness, Likability and Perceived Restorative Quality of the schoolyard in the control and intervention groups at baseline (T0), first follow-up (T1) and second follow-up (T2), with higher scores indicating a more positive appreciation of the schoolyard. Error bars represent the 95% CI. All scores are adjusted for gender and grade level.

Impacts of schoolyard greening on children’s appreciation were moderated by grade and gender. At first follow-up, there was a significant three-way interaction between group 5,

condition and time for attractiveness, $z = -2.00, p < .05$, and likability, $z = -2.62, p < .01$. At second follow-up, there was a significant three-way interaction between group 6, condition and time for attractiveness, $z = -1.98, p < .05$, likability, $z = -3.01, p < .01$, and restorative quality, $z = 1.06, p < .001$. Exploration of these moderating effects reveals that at first follow-up, effects of greening schoolyards on perceived attractiveness and likability were stronger for groups 4 and 6 than for group 5, $ps < .05$, while at second follow-up effects of greening schoolyards on perceived attractiveness and likability of the schoolyard were generally stronger for groups 4 and 5 than for group 6, $ps < .05$. Children in grade 4 and 5 in the intervention school also perceived their schoolyard to be somewhat more restorative at second follow-up, compared to baseline. Grade level did not moderate the influence of greening schoolyards on perceived naturalness of the schoolyard. At first follow-up there was also a significant interaction between gender, condition and time on attractiveness of the schoolyard, $z = 2.69, p < .01$, and at second follow-up there was a trend for this three-way interaction, $z = 1.83, p = .07$. Exploration of these moderating effects showed that the impact of greening schoolyards on perceived attractiveness was on average stronger for girls than for boys. Gender did not moderate impacts of greening on perceived naturalness, likability and restorative quality, $ps > .1$.

Overall, the results support the hypothesis that children show greater appreciation of the schoolyard after their schoolyard has been greened, this holds in particular for younger children and for girls.

Attention restoration

In general, children's scores on the two attentional tasks improved after recess, which may be due to a learning effect, or a general impact of having a break. At baseline, there were no significant differences in the attention-improving effect of recess between intervention and control schools, neither for the DLST nor the SST, $ps > .4$. At second follow-up, there was a

significant interaction between time and condition for the improvement in DLST after recess and a trend for this interaction for the improvement in SST, $p = .08$. As illustrated in Figure 4, at second follow-up children in the intervention condition show on average greater improvement in scores on the DLST and SST than children in the control condition. For both attentional tasks, there were no significant interactions at first follow-up, nor did gender and grade moderate the effects, $ps > .1$. Taken together, the results support the hypothesis that greening a schoolyard improves children's attention restoration during recess, this holds for both attentional tasks, but only after the schoolyard had already been greened for a longer period.

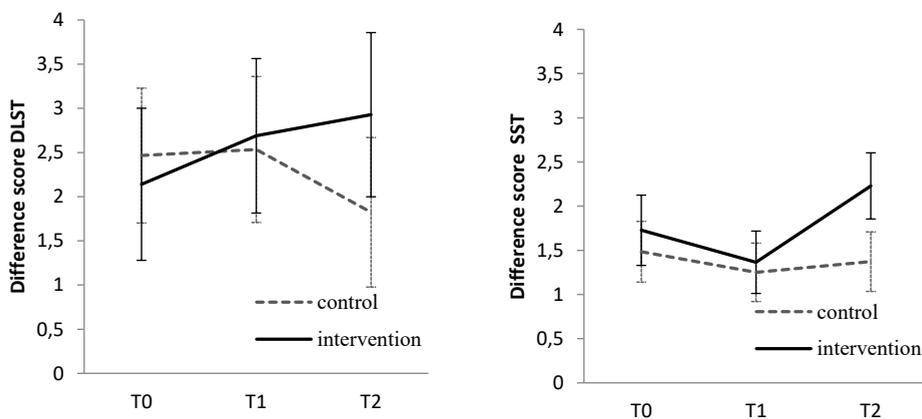


Figure 4. Difference scores between before and after recess on the DLST (left) and SST (right) task in the control and intervention groups at baseline (T0), first follow-up (T1) and second follow-up (T2). Higher scores represent greater improvement in attentional functioning after recess. Error bars represent the 95% CI. All scores are adjusted for gender and grade level.

Physical activity

At baseline, there was no significant difference between children in the control and intervention condition in percentage of time spent in MVPA during recess, $p < 1$. There was an

overall increase in percentage of time children spent in MVPA during recess at both follow-up measurements, as indicated by a significant main effect of time across the two-follow-ups. There was no significant main effect of condition. However, as illustrated in figure 5, the overall trend for impact of greening on physical activity was positive, no significant interactions between time and condition were found, $ps > .2$, but the effects of greening the schoolyard were moderated by gender. At first follow-up there was a significant three-way interaction between gender, condition and time, $z = 2.15, p < .05$. As illustrated in figure 5, at baseline, girls in the intervention condition spent on average a significantly lower percentage of time in MVPA during recess than girls in the control condition. During first follow-up, the percentage of time girls at the intervention schools spent in MVPA during recess increased, compared to baseline. Whereas, the percentage of time girls in the control condition spent in MVPA at first follow-up remained similar to baseline. As a result, the baseline difference is no longer present at first follow-up. At second follow-up, although the baseline difference is still no longer present, the three-way interaction is not significant, $p = .16$. No significant impact of greening schoolyards on physical activity was found for boys, $ps > .6$. There were also no significant moderating effects of grade on the impacts of greening schoolyards on physical activity.

Overall, the results show some support for the hypothesis that greening a schoolyard stimulates physical activity, but only in girls and in particular shortly after the schoolyard has been greened.

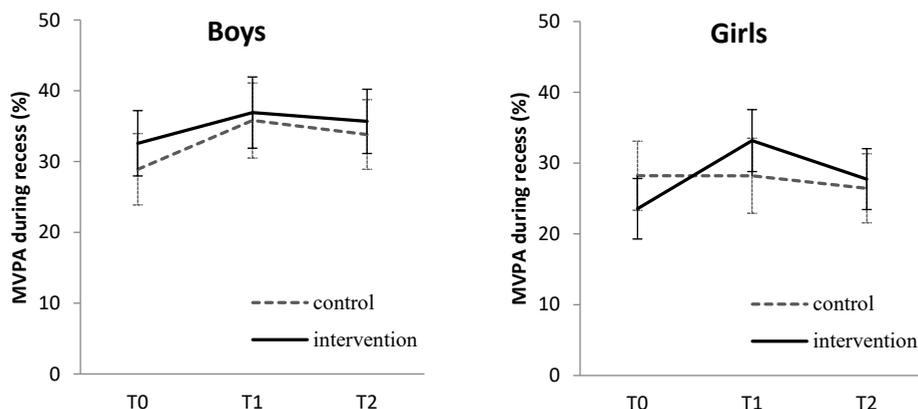


Figure 5. Percentage of time spent in Moderate to Vigorous Physical Activity (MVPA) during recess in control and intervention groups at the three times of measurement, baseline (T0), first follow-up (T1) and second follow-up (T2), for boys (left) and girls (right). Error bars represent the 95% CI. All scores are adjusted for grade level.

Prosocial orientation

At baseline, there was no significant difference between the control and the intervention condition in percentage of children with a prosocial orientation, as measured by the Social Orientation Choice Card, $p = .32$. There was a significant main effect of time at second follow-up, indicating a higher percentage of children with a prosocial orientation at both the intervention and the control schools. There were no significant interactions between time and condition at both follow-ups, $ps > .25$.

Grade moderated the impacts of greening on prosocial orientation at first follow-up as indicated by a trend for the three-way interaction between grade 5, condition and time, $z = 1.66$, $p = .097$, and a significant interaction between grade 6, condition, and time, $z = -2.53$, $p < .05$. As can be seen in Figure 6, percentages of children with prosocial behavior in grades 4 and 5 of the intervention schools, in comparison to control schools, increased more from baseline to

first follow-up, while in grade 6, there was a significant decrease in the percentage of children with a prosocial orientation. At second follow-up, there were no significant differences in percentages of children with a prosocial orientation between the control and intervention schools in all grades, $ps > .1$. These results provide some support for a positive short-term impact of greening the schoolyard on younger and a negative impact on older children's prosocial orientation.

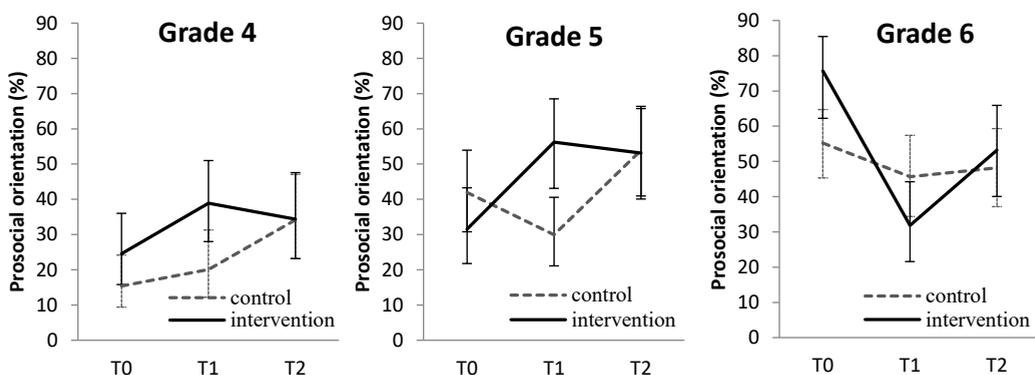


Figure 6. Percentage of children with a prosocial orientation on the Social Orientation Choice Card in control and intervention groups at the three times of measurement, baseline (T0), first follow-up (T1) and second follow-up (T2), for children in grade 4 (left), grade 5 (middle) and grade 6 (right). Error bars represent the 95% CI. All scores are adjusted for gender.

Self-reported social behavior

There were no significant baseline differences between children in the control and intervention schools in self-reported prosocial behavior and peer problems, $ps > .1$. Children in the intervention condition did, however, experience less social support in their friendships than children in the control condition, $p < .0001$. There were significant main effects of time at both

follow-ups for self-reported peer problems and social-support, and a significant main effect of time only at second follow-up for social support. There were no significant main effects of condition. Main effects of time were qualified by significant interactions between time and condition for peer problems only at first follow-up, and for social support at both first and second follow-up. As illustrated in Figure 7, children in the intervention condition reported significantly fewer peer problems at first follow-up, compared to baseline. At second follow-up, both children in intervention and control schools report significantly fewer peer problems, compared to baseline. Furthermore, children in the intervention condition significantly reported more social support during both first and second follow-up, compared to baseline, whereas, children in the control condition experienced significantly less social support at first follow-up. As a result, the baseline difference between control and intervention schools in social support was no longer present at both follow-up measurements, $ps > .7$. No significant interactions between time and condition were found for self-reported prosocial behavior, $ps > .2$.

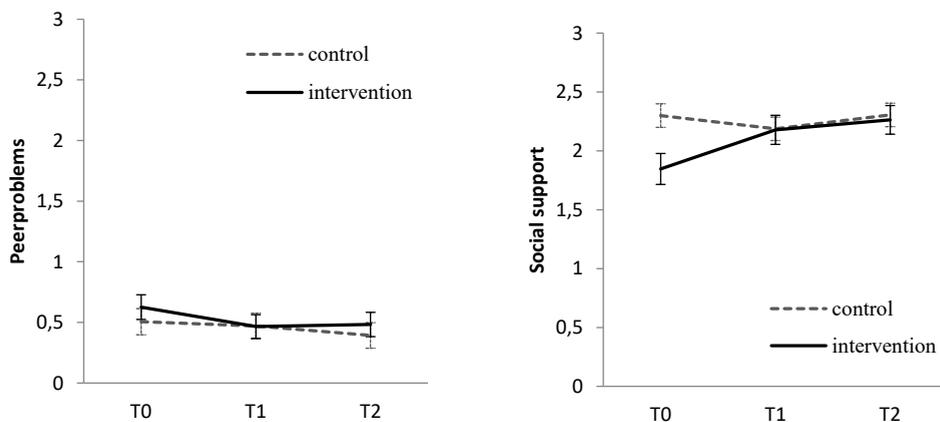


Figure 7. Scores on the self-reported peer problems and support in control and intervention groups at the three times of measurement, baseline (T0), first follow-up (T1) and second follow-up (T2). Error bars represent the 95% CI. All scores are adjusted for gender and grade level.

At first follow-up there were significant interactions with condition and time for grade 5, $z = 2.55$, $p < .05$, and for grade 6, $z = 2.88$, $p < .05$, indicating that the positive effect of greening schoolyards on social support was only present in grade 5 and 6. At second follow-up grade did not moderate the effect, the positive effect was present in all three grades. Grade did not moderate the results on self-reported prosocial behavior and peer problems, nor did gender moderate the results on any of the three outcome measures, $ps > .09$.

Taken together, the results partly confirm the hypothesis that greening a schoolyard is beneficial for children's social functioning. In particular for social support and self-reported peer problems, but not for self-reported prosocial behavior.

Emotional functioning

At baseline, there was no significant difference between children in the control and the intervention condition in their emotional functioning, $p = .69$. There were no significant main effects of time or condition, $ps > .5$, nor did there emerge significant interactions between time and condition, $p > .41$. Gender and group do not moderate the results, $p > .30$. Thus, the results do not support a positive impact of greening schoolyards on children's emotional functioning.

Table 2. Unadjusted means and standard deviations of outcome measures in control and intervention groups at three times of measurement (T0 = baseline, T1= first follow-up, T2=second follow-up).

Outcome measure	Baseline		Follow-up 1		Follow-up 2	
	Control	Intervention	Control	Intervention	Control	Intervention
<i>Perception Schoolyard</i>						
Naturalness	2.80 (1.21)	2.89 (1.23)	2.80 (1.23)	3.74 ^{*****†} (1.19)	2.93 (1.16)	3.76 ^{*****†} (1.21)
Likability	7.01 (2.15)	6.40* (2.46)	6.72 (2.09)	7.15 ^{†††} (2.32)	7.01 (1.94)	7.13 ^{†††} (2.40)

Attractiveness	3.65 (0.79)	3.54 (0.89)	3.59 (0.78)	3.77 ^{†††} (0.88)	3.66 (0.73)	3.73 ^{††} (0.83)
Restorative quality	2.55 (0.67)	2.58 (0.69)	2.50 (.66)	2.59 (0.71)	2.60 (0.60)	2.60 (0.73)
<i>Attention</i>						
DLST	2.44 (5.24)	2.11 (5.93)	2.54 (5.76)	2.70 (5.92)	1.71 (6.04)	2.95* (6.02)
SST	1.48 (3.03)	1.73 (2.95)	1.23 (2.69)	1.36 (2.78)	1.35 (2.80)	2.22* (2.76)
<i>Physical activity</i>						
Time spent in MVPA (%)	28.33 (15.61)	27.80 (16.97)	32.00 (16.22)	34.76 ^{†††} (18.16)	30.08 (15.43)	31.46 ^{††} (17.37)
<i>Social Behavior</i>						
SOCC: Prosocial orientation (%)	37.22	41.88	32.04 ^l	44.17 [†]	45.20 [†]	48.37 [†]
Prosocial	2.23 (0.54)	2.24 (0.60)	2.23 (0.56)	2.26 (0.61)	2.33 (0.49)	2.23 (0.57)
Peer problems	0.50 (0.66)	0.63 (0.72)	0.46 (0.62)	0.46 [†] (0.63)	0.37 [†] (0.57)	0.49 [†] (0.68)
Social support	2.30 (0.61)	1.85* (0.96)	2.19 [†] (0.58)	2.18 [†] (0.65)	2.29 (0.51)	2.27 [†] (0.54)
<i>Emotional well-being</i>						
	3.75 (0.82)	3.77 (0.81)	3.64 (0.73)	3.58 (0.82)	3.59 (0.75)	3.56 (0.76)

Means indicated with an asterisk differ significantly from the mean in the control group at the same time of measurement, after controlling for gender and grade level, * $p < .05$; ** $p < .01$; *** $p < .001$; means indicated with an obelisk differ significantly from baseline within the same condition after controlling for gender and grade level, [†] $p < .05$; ^{††} $p < .01$; ^{†††} $p < .001$

Table 3. Overview of overall (χ^2) as well as individual (Z) outcomes of multilevel analyses of the follow-up scores with time (T0, T1, T2) as a within-subjects factor and condition (control, intervention) as a between-subjects factor, and gender and grade level as covariates.

Outcome measure		Condition (df = 1)	Time (df = 7)		Interaction condition*time (df = 2)	
			Follow-up 1 (T1)	Follow-up 2 (T2)	Condition * T1	Condition * T2
<i>Perception schoolyard</i>						
Naturalness	Z	0.30	0.00	1.69	8.40***	7.52***
	χ^2	6.33*	94.12***		77.97***	
Likability	Z	-2.02	-1.75	-0.23	4.53***	3.59***
	χ^2	0.02	38.46***		21.06***	
Attractiveness	Z	-1.09	-1.18	-0.26	3.76***	3.45***
	χ^2	0.03	21.78***		15.93***	
Restorative quality	Z	0.14	-1.20	0.67	1.09	0.55
	χ^2	0.45	12.78		1.22	
<i>Attention restoration</i>						
DLST	Z	-0.55	0.16	-1.42	0.72	2.07*
	χ^2	0.27	7.06		4.29	
SST	Z	0.91	-1.03	-0.48	-0.38	1.75
	χ^2	3.57	9.828		6.15*	
<i>Physical activity</i>						
MVPA	Z	-0.27	1.52	0.72	1.37	0.81
	χ^2	0.34	19.45**		1.90	
<i>Social Behavior</i>						
SOCC (% prosocial)	Z	1.00	-1.32	1.76	1.12	-0.48

	<i>Chi</i> ²					
Prosocial	<i>Z</i>	-0.54	-0.54	2.43*	0.88	-1.35
	<i>Chi</i> ²	1.23		19.20*	5.50	
Peer problems	<i>Z</i>	1.60	-0.82	-2.33**	-1.98*	-0.43
	<i>Chi</i> ²	1.10		30.90***	4.76	
Social support	<i>Z</i>	-4.58***	-2.29*	0.12	6.42***	5.79***
	<i>Chi</i> ²	2.29		137.15***	42.21***	
<hr/>						
<i>Emotional well-being</i>						
Emotional functioning	<i>Z</i>	0.40	-2.30*	-3.00**	-0.83	-0.25
	<i>Chi</i> ²	0.04		32.00***		0.79

* $p < .05$; ** $p < .01$; *** $p < .001$ *

Discussion

We conducted a prospective intervention study with a two-year follow-up to investigate the impact of greening schoolyards on schoolchildren's (aged 7-11) appreciation of the schoolyard, and their physical, cognitive, and social-emotional well-being. Results showed that, in line with the hypotheses, after their schoolyard was greened, children perceived it to be more natural compared to their previously paved schoolyard and to children whose schoolyard stayed paved. Furthermore, also consistent with our expectations, greening schoolyards had a positive impact on children's appreciation of the schoolyard, attentional restoration after recess and social well-being. The hypothesized positive effect of greening schoolyards on physical activity was partially confirmed only for girls.

Contrary to the expectations, greening had no impact on children's perceived restorative quality of the schoolyard. However, the greater improvements in their performance on

attentional tasks from pre- to post-recess are in line with Attention Restoration Theory (Kaplan, 1995) which predicts that contact with green space can help to replenish depleted cognitive resources. The finding that restorative effects of greening only occurred after the schoolyards had already been greened for a longer period, is along the lines proposed by Collado and Staats (2016) that attention restoration is related to children's familiarity with and interpersonal relation to natural places.

The finding that in particular girls became more active after greening their schoolyard is consistent with previous studies that also showed a differential impact of greening schoolyards for boys and girls (Fjørtoft et al., 2009a; Pagels et al., 2014). In the light of Affordance Theory (Gibson, 1979), these findings could be explained by Fjørtoft et al. (2009a) who found that boys tend to be more attracted to paved areas in schoolyards that afford high speed activities as running and soccer playing. Girls on the other hand showed more interest than boys in green areas, where they engaged in more physically active behaviors. Further, the overall, but not significant, results could be explained by the assumption that green schoolyards in general could afford physical activity at lower speed, but more physically intense through motor activities as climbing a hill or tree. In the present study, the positive impact of greening on girls' activity levels was only found at first follow-up. However, at second follow-up girls at the schools with greened schoolyards remained at least equally active as girls at the control schools, whereas they were less active at baseline.

The finding that children reported fewer peer problems and more social support after the greening, supports previous studies, as well as the Theory of Loose Parts (Nicholson, 1972) and Affordance Theory (Gibson, 1979), that greening schoolyards affords more cooperative and prosocial play, and thereby fosters children's social well-being (Chawla et al., 2014; De Vries et al., 2013; Maas et al., 2013). Measurements of children's prosocial orientation provided

further objective evidence for these notions, but only for younger children and only shortly after greening.

Although the biophilia hypothesis (Kellert & Wilson, 1995) and Stress Recovery Theory (Ulrich, 1983) suggest that engagement with nature has beneficial effects for children's emotional well-being, our results do not support this claim. One explanation for this could be that children reported relatively little emotional problems at baseline, which could indicate that there was not much room for the intervention to foster emotional well-being. Also, emotional well-being is influenced by a variety of factors and our methodology could be too limited to capture the full impact of greening schoolyards on schoolchildren's emotional well-being. The finding that greening schoolyards was especially beneficial for girls and younger children suggests that the greening may not have been compatible with the needs and abilities of boys and older children. This suggests that schoolyards in the current project could be further developed and used in ways that make them inclusive and support the well-being of all children, regardless of their gender and age.

Strengths and Limitations

The present study addressed many of the shortcomings of previous research on greening schoolyards by employing a design with matched control groups and several follow-up measurements. We also combined self-report measurements with objective tests. However, the research is not without limitations.

First, we followed a quasi-experimental design, as it was not possible to randomly assign schools to intervention or control conditions. This may have led to a selection bias, as schools made a conscious choice to re-design their schoolyards. However, intervention and control schools were carefully matched on aspects such as socio-economic status and level of urbanization. Furthermore, random assignment of greening would seem inappropriate, because

greening schoolyards requires long-term investments of teachers and parents. Without these investments, chances are that the greening will be unsuccessful and not lead to a positive impact on children's well-being (Maas et al., 2014).

Second, the project only included schools from moderate-to highly urbanized areas. The question remains whether our results can be generalized to children living in more rural, green areas. Generalizability can be increased by expanding the sample with elementary schools varying in level of urbanization, as well as socio-demographic aspects.

Third, the quantity and quality of greening possibly influenced our results, leading to an underestimation of the impact of greening schoolyards for children's well-being. Although, all intervention schools had plans to substantially green their schoolyards, the actual greening was modest in some cases and all greened schoolyards still contained some paved areas. As a result, potential benefits of the greening may not have been fully realized because the greening did not allow children to really immerse themselves in nature and engage in the meaningful experiences as described by several theories. It is also possible that children still predominantly played at the paved areas. Martensson et al. (2014) for example found that although most children mark natural areas as their most favorite, this was not the area where they mostly played. The video observations of children's behavior in the schoolyards, which are still under analysis, may provide more insight in these issues. However, after two years at second follow-up the schoolyards of the intervention schools were still green and well-maintained. During the data collection, on every intervention school the principal and teachers talked about ideas to further green their schoolyard and increase the use of the schoolyard as a learning environment. In this light, the present study could be a first positive indicator of the impact of greening schoolyards with more promising future results.

Fourth, we used a between-subjects design which enabled us to eliminate noise in the data related to children's maturation and unrelated events occurring between the measurements.

However, this design does not allow any conclusions about the impact of greening schoolyards on children's individual development over time. For such a study a within-subject design would be more suitable.

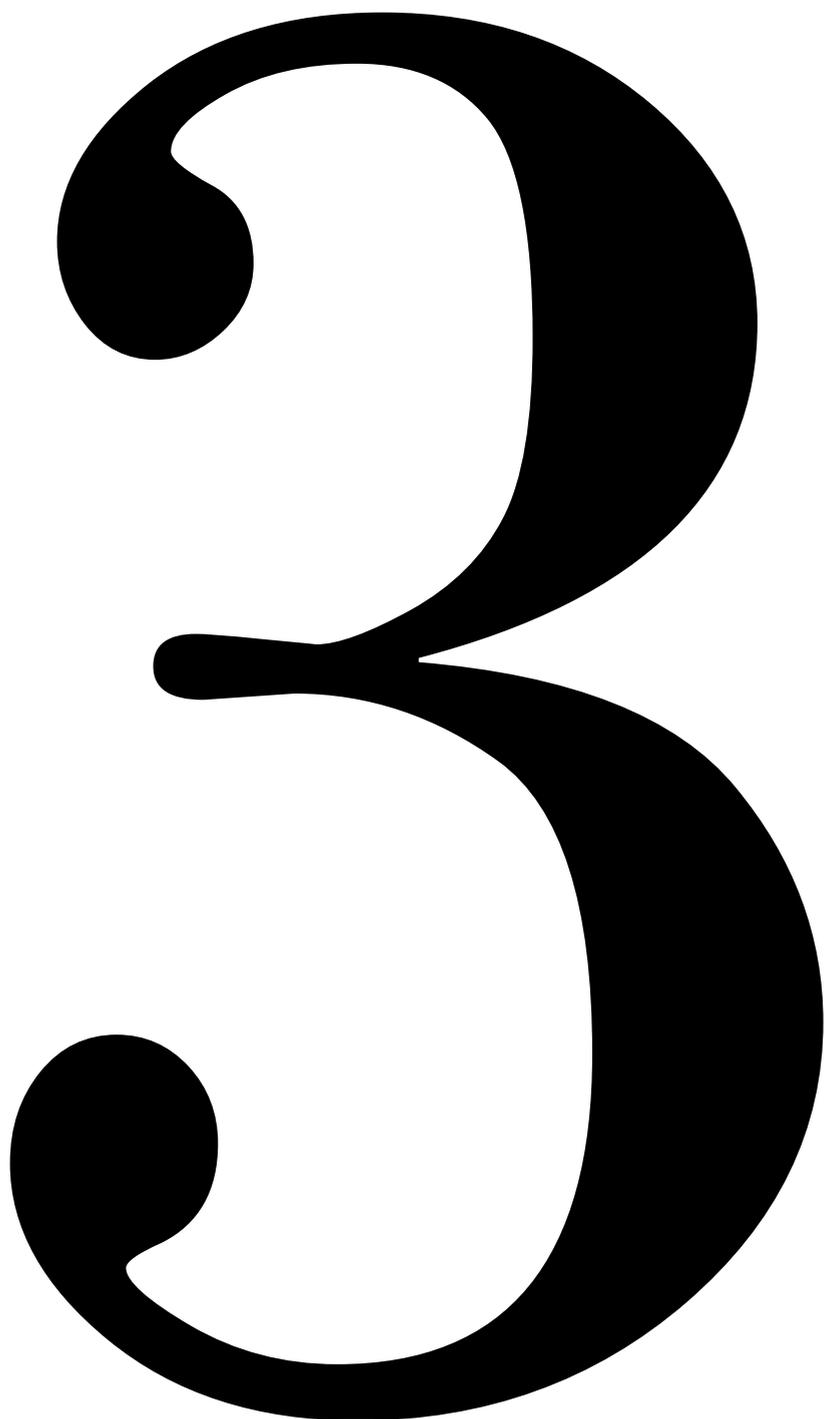
Lastly, data collection was limited to one day a year at each school over three consecutive years. This could have led to random errors, such as coincidence of time, weather conditions, novelty effects, or something out of the ordinary happening during recess or in the classroom. However, data collection on each school each year was scheduled in approximately the same period, researchers followed a strict protocol, and special occasions were avoided.

Conclusion and implications

In this longitudinal project we obtained support for a positive impact of greening schoolyards on children's appreciation of the schoolyards, and their cognitive and social well-being. Furthermore, we found some indications that greening schoolyards is a promising intervention to stimulate in particular girls to become physically active and that it can support pro-social behavior amongst younger children. To our knowledge, this is the first study on the impact of greening schoolyards that employed both a longitudinal design and proper control groups. In future research, our approach could be replicated and extended by, for instance, selecting schools from various socio-economic contexts and by including multiple days of data collection. Furthermore, we would advise researchers and schools to co-design green schoolyards, as to further understand how certain green areas in schoolyards afford children's experiences and thereby foster their well-being. This could stimulate designing inclusive green schoolyards that foster the well-being of all children.

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Chapter 3

The Impact of Greening Schoolyards on Schoolchildren's Play and Non-Play Behavior

This chapter is based on Van Dijk-Wesselius, Maas, J., van Vugt, M.
& van den Berg, A.E.

The impact of greening schoolyards on schoolchildren's play behavior (2020).
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Abstract

This paper investigates the impact of greening schoolyards on children's (age 7-11) play and non-play behavior during recess. Five primary schools in The Netherlands took part in a longitudinal prospective intervention study with a two-year follow-up. At baseline, all schoolyards were paved. Between baseline and follow-up all schools greened their schoolyards. During recess, video observations were made and afterwards coded using the cognitive play categories and non-play categories of the Play Observation Scale (Rubin, 2001). Results show an increase in observed play, as compared to non-play, behavior, after greening. Furthermore, we observed an increase in games-with-rules, a small increase in constructive and exploratory play behavior, and a decrease in passive non-play behaviors. This impact of greening was stronger for girls compared to boys. These findings strengthen the empirical basis for greening schoolyards as a means to create inclusive playscapes that serve the needs of all children.

Keywords: Affordances, creative play, exploratory behavior, green space, loose parts

Over the past decades a growing number of primary schools across many different countries have taken the initiative to re-design their schoolyard with natural features such as trees, flowers, sand, water, grass, hills and bushes to create a more attractive 'green schoolyard' (Bell & Dymont, 2008; Van Dijk-Wesseliuss, Maas, Hovinga, Van Vugt, & Van den Berg, 2018). This green schoolyards movement is inspired by research indicating multiple benefits of greening schoolyards for children, schools and communities (Lamar & Jordan, 2016). One of the benefits that is frequently cited in the literature is that green schoolyards offer more varied play opportunities that meet the interests of all children and support children's healthy development (Root, Snow, Belalcazar, & Callary, 2017). In particular, a green, compared to a paved, schoolyard, is thought to encourage more creative and exploratory play (Lucas & Dymont, 2010; Zamani, 2016). However, there is a lack of direct, quantitative evidence for the idea that greening a schoolyard encourages more varied play behavior among school-aged children. The aim of the current study is to examine the impact of schoolyard greening on primary school children's play and non-play behavior during recess using a pre-posttest intervention study with systematic behavioral observations.

Children's play behavior

For the purpose of the current study we adopt a broad definition of play as a voluntary, intrinsically motivated behavior, that is self-chosen and self-directed, and allows children to quit if they are not having fun (Gray, 2017). Play is generally considered an essential and critical part of children's healthy development (Graham & Burghardt, 2010; Nijhof et al., 2018). From this perspective, schoolyards and other play areas can be considered of higher quality when children display more play (as compared to non-play) behavior (Luchs & Fikus, 2013; Stanley, 2011). In line with (Piaget, 1962) and (Smilansky, 1968) play behavior can be categorized in terms of a variety of physical/locomotor, social, and cognitive skills that children can practice

in play. In this study, the focus is on play behavior that supports the development of cognitive skills. Following a widely used classification scheme, these cognitive play behaviors can be subdivided into five broad categories (Rubin, 2001) (1) Functional play – use of objects as they are intended to, (2) Games-with-rules – the acceptance of explicit rules that are agreed upon and provide boundaries for competition (3) Constructive play – manipulation of objects to construct or ‘create’ something; (4) Dramatic or pretend play – engage in imaginary situations, (5) Exploratory play - a focused examination of objects (or other people or situations) in the environment. Within this spectrum of cognitive play behaviors, more creative play behaviors (i.e., constructive and dramatic play) have traditionally been valued for their contribution to the development of cognitive and social skills (Burriss & Tsao, 2002). As already pointed out by (Piaget, 1962), creative play, among other things, provides children with opportunities to reproduce real-life conflicts, to work out ideal resolutions for their own pleasure, and to ameliorate negative feelings. Additionally, exploratory play behavior is also highly valued for its supportive role in causal learning and inductive reasoning (Schulz et al., 2008), which are central to the working of intelligence (Perret, 2015). Moreover, in natural environments, exploratory behavior can foster children’s connection to nature by acquiring direct ‘hands-on’ sensory and physical knowledge of their natural surroundings (Gurholt & Sanderud, 2016).

Theoretical background: Affordances and loose parts

Even though children are intrinsically motivated to engage in play, properties of the play environment influence children’s play behavior by offering different types of play opportunities. Gibson’s (1979) Affordance Theory provides a framework for understanding this influence of the environment on play. This theory states that the physical environment affords different actions and behaviors which correspond with an individual’s body size, strength, skills, fears and other needs and abilities. For instance, a tree only affords climbing if a child can reach to the lowest branch or something is only grabbable if it fits in the hand of the child.

As such, affordances can be defined as functionally significant properties of the environment that are delineated by the relationship between the environment and an organism. Heft (1988) elaborated Gibson's theory by proposing a taxonomy of affordances in children's environments, such as a "climb-on-able feature" and a "swing-on-able feature". Kytä (2004) further extended this work by distinguishing between potential and actualized affordances, the latter of which constitute the subset of the potential affordances that a child actually perceives, utilizes, or shapes. She also emphasizes the importance of children's independent ability to move around outside the control of adults as a precondition for enabling children to actualize potential affordances.

The theory of affordances emphasizes the importance of designing schoolyards that provide opportunities for children to immerse in different types of play behavior, and that suit individual needs and abilities of all children (Tranter & Malone, 2004; Wilson, 1997). However, traditional, paved schoolyards are in general considered one-dimensional, non-responsive and restricted in the forms of play behaviors they afford in children (Woolley & Lowe, 2013). Several studies highlight that traditional schoolyards mostly appeal to boys' interests, who dominate the schoolyard with competitive and rule-bound games (Brez & Sheets, 2017; Sharma-Brymer & Bland, 2016). Furthermore, built equipment on traditional schoolyards can foster uncomfortable power relations based on children's physical competence, which may negatively influence participation in play behaviors (Dyment & O'Connell, 2013; Lucas & Dyment, 2010). In contrast, green schoolyards with natural features are assumed to be more open and flexible in the potential affordances children can actualize in interaction with the environment (Heft, 1988) and stimulate more varied, creative and physically active play behavior (Drown & Christensen, 2014; Fjørtoft et al., 2009a).

The importance of natural features is further explained by the Theory of Loose Parts (Nicholson, 1972) that emphasizes the importance of open and unstructured features in an

environment. The loose parts that can be found in natural environments, such as twigs, leaves, sand and water, tend to be less set and more fascinating than ready-to-use (synthetic) play equipment, like a climbing frame or a ball. Loose parts in natural environments invite children to move around, design, re-design, and decide on goals and meanings themselves. Children love to interact with natural features that are flexible, capture and hold their attention and stimulate their senses (Chawla & Nasar, 2015; Dymont & O'Connell, 2013). As such, loose parts, which are naturally present in nature, create numerous opportunities for children to engage in constructive, imaginative and exploratory play behavior (Engelen et al., 2017).

Greening schoolyards: Empirical findings

The idea that green schoolyards afford more varied, creative and exploratory play opportunities than traditional non-natural, paved schoolyards is supported by a design evaluation study in the UK (Woolley & Lowe, 2013). In this study, ten playgrounds with varying degrees of naturalness were assessed using an evaluation tool that comprised dimensions of play value, physical characteristics and environmental characteristics. Play value was found to increase along a continuum, with more natural features leading to a higher play value in terms of more active, varied, creative, sensory and multidimensional play behavior. These findings are confirmed by an ethnographic study in Canada, which compared the affordances of a biodiverse schoolyard with complex vegetation and a relatively barren schoolyard using drawings, surveys and interviews amongst children aged 6-13 (Samborski, 2010). Findings show that the biodiverse schoolyard afforded a richer play experience, with more varied play opportunities. Drawing on ethnographic observations and interviews, another study among children of primary schools with partially green schoolyards in the US found that children prefer to play in the green areas on schoolyards and that in these areas children

expressed that they can choose activities they feel comfortable with and that suit their competence (Chawla et al., 2014).

An observational study among Swedish pre-school children (age 5-7) who played for nine months during recess in a forest nearby showed that natural features of the forest afford and facilitate a multitude of play behaviors (Fjørtoft & Sageie, 2000). Children, for instance, used loose parts like branches to construct shelters and used rocks and trees for climbing and sliding. In this study, it was also found that children who played in the forest for nine months showed more progress in motor fitness compared to a reference group who played in a traditional schoolyard (Fjørtoft, 2004). An Australian study among 8-10 year old children of five primary schools with schoolyards with differing degrees of naturalness found that two-fifths of the behavior during recess at the school with the most natural schoolyard were imaginative, constructive and exploratory activities, whereas the school with the least natural schoolyard had no observations in this category (Malone & Tranter, 2003). Another systematic observational study among preschoolers aged 5-6 in Germany revealed more complex forms of play as well as more long-lasting play episodes in natural playgrounds compared to contemporary playgrounds with artificial, monofunctional play equipment (Luchs & Fikus, 2013).

Several studies suggest that greening schoolyards can create an inclusive schoolyard that is more sensitive for the needs of both boys and girls than a traditional paved schoolyard (Dyment & Bell, 2008; Lucas & Dyment, 2010). Furthermore, a study at two Swedish schools, one with little and one with substantial greening, amongst children aged 10-13, found that in paved areas girls were often hanging passively around soccer fields and were not engaged in play behavior. Whereas in green areas, girls were more actively engaged in play themselves (Mårtensson et al., 2014).

In sum, there is much indirect support from studies comparing green vs. paved playgrounds for the notion that greening schoolyards promote play in general, and more varied and inclusive play in particular. However, few studies have directly examined the impacts of greening a schoolyard on the play behavior of school children. A survey study among 59 Canadian primary schools that greened their schoolyard provides some preliminary support that greening can have an impact on children's behaviors (Dyment & Bell, 2007b). In this study, teachers, parents and administrators confirmed that through greening, schoolyards appeal to a wider variety of children's interests and support a wider variety of play activities, like more imaginative and constructive play behavior. A study on the impact of greening part of a 'lab schoolyard' of a university in the US found that greening promotes exploratory and investigative play in children aged 4-8 who were observed in the schoolyard before and after the experimental schoolyard was re-designed (Kuh, Ponte, & Chau, 2013). This change was attributed to the presence of loose parts, multiple pathways and natural features.

The present research and hypotheses

The present study addressed the need for more direct, empirical evidence from systematic observational studies regarding the impact of greening schoolyards by comparing schoolchildren's cognitive play behavior and non-play behavior before and after schoolyard greening. Video-observations obtained in a pre-posttest intervention study among five primary schools with a baseline and two-year follow-up were systematically coded and analyzed to test for the hypotheses that after greening:

H1: Children show an increase in observed cognitive play behavior and a decrease in non-play behavior.

H2: Children show more varied cognitive play behavior.

H3: Children show an increase in constructive, dramatic and exploratory play behavior.

In addition, we explored the impact of greening schoolyards on various types of non-play behavior, and whether the impact of greening differs between girls and boys.

Method

Overview and design

The data presented in this paper are part of a large, four-year research program investigating the impact of greening schoolyards of primary schools in moderate-to-high-urbanized areas in The Netherlands on several outcome measures (Van Dijk-Wesselius et al., 2018). The current paper discusses results of video-observations of children's behavior in schoolyards of five intervention schools made at baseline in 2014 before greening and at follow-up in 2016 after greening.

The Research Ethics Committee of the department of social- and organizational psychology from the Vrije Universiteit Amsterdam approved the study and affirmed that the study would not induce negative consequences above minimal risk for the participating children. The study and study protocol were also approved by the school boards. Furthermore, a passive consent procedure was conducted by sending a letter to the children's parents in which the aim of the study was explained and in which parents were informed how they could withdraw their child from participation. The parents of two children across all schools and measurements refused to let their child participate.

Schools and Participants

Two criteria were used to select the participating schools. Participating schools should have advanced plans for greening their schoolyard between 2014 and 2015 and should be located in urbanized areas with limited green play opportunities for children. For more details about the selection process see Van Dijk-Wesselius et al. (2018).

During recess, video observations were targeted to include the behavior of all children present in the schoolyard. We did not collect data on individual children. However, approximately 350 children at baseline (56% boys) and 360 children at follow-up (51% boys), aged seven to eleven in group 4, 5 and 6 (as classified by the Dutch educational system) were included in the observations.

Schoolyard greening

The greening of the five schoolyards was a tailored process supported by a regional funding agency (Fonds1818). Funding was allocated based on the design, quality, shape and functionality of the schoolyard greening which schools had to describe in a detailed plan. When this plan was approved, the greening was carried out in a participatory process with input from parents, teachers, children and designers. Figure 1 gives an impression of each schoolyard before and after greening. The greening only affected the design of the schoolyard, the sizes of the schoolyards remained the same at each school.

The designs of the schoolyards

School A. At baseline, the schoolyard (of approximately 920m²) was entirely paved and included a soccer area, a table tennis table, two sandpits, a wooden house with climbing elements and a slide, and a large stony structure that stands out in relief on the pavement. At follow-up, the schoolyard was still mainly covered with tiles and the soccer area, table tennis table and sandpit were still present. The greening resulted in the addition of a wooden house surrounded by woodchips, a feature with artificial grass that holds a small muddy slope, a tunnel, a slide and a low bridge, and an amphitheater made from stones.

School B. At baseline the schoolyard (of approximately 795 m²) was almost entirely paved, except for some trees and a surrounding hedge. Play equipment included a climbing

feature with rubber mats, a bench around a tree, a running track and some round and half round stony features. At follow-up, the schoolyard was still mainly covered with tiles. The climbing element was still present, but now with woodchips underneath instead of rubber mats. The greening resulted in the addition of a hut made of willow branches, an amphitheater made of stones, and a hill made from sand, woodchips and tree trunks with a tunnel and a slide. This hill feature was surrounded by woodchips, tree trunks and some vegetation.

School C. At this school the schoolyard was divided in two playing areas, with a total size of approximately 565m². At baseline, the vast majority of both areas of the schoolyard was entirely covered with tiles. In one of the two areas, there were two trees standing in the middle of the schoolyard, but without low branches for children to reach. The areas included features like swings, a climbing rope and swinging rope and two picnic tables, a broken tennis table, a fun korf and two high bars. At follow-up, both areas of the schoolyard were still mainly covered with tiles, with some newly added non-natural features such as a marked running course, a soccer and baseball area, and two new swings. The greening resulted in the addition of natural features in both areas, including a grassy area, a demarcated path with stones, a bridge, a tunnel made from branches, a hill with paths made from stones and wood, a walking net between two wooden poles, and tree trunks surrounded by woodchips and sand. Along the edges of the schoolyard and in the middle, there is vegetation with small trees, bushes and flowers, but children are not allowed to play in these places.

School D. At baseline, the schoolyard (of approximately 698 m²) was almost entirely covered with tiles. There were two high bars with rubber mats, a fun korf, a tree surrounded by benches, a table tennis table and a marked soccer goal with numbers on a wall. At follow-up, the schoolyard was partly covered with woodchips and partly paved, and still contained a table tennis table, marked goal on a wall, a bench around a tree and high bars, but now with woodchips underneath. The greening resulted in the addition of a wooden monkey bar with

several climbing elements and walking bridges. Further, there is a small wilderness area with a path between bushes bordering the monkey bar, an amphitheater with a flower bed on the edge, a strip of woodchips with small tree trunks and a strip of woodchips with a hut made from willow branches and some vegetable gardens.

School E. At baseline, the schoolyard (of approximately 1660 m²) was entirely covered with tiles. There were three high bars, a small stony structure, an amphitheater with a row of plants on the edge and a fun korf. The schoolyard borders a communal playground that children can visit during recess. In this area there is a soccer court and a baseball court. In addition, there is a colorful play structure with a slide and climbing net, a spin feature, a spring toy, two swings, two benches and a climbing rack with a twist bar. After greening, the schoolyard was still mainly covered with tiles, and the amphitheater with a row of plants on the edge, the fun korf and three high bars were still present. The greening process resulted in the addition of a grassy hill with a tunnel and bridge. On each side there are different paths up and down the hill constructed from natural features like tree trunks, bushes and flowers. The communal playground remained unchanged.



School A: Baseline



School A: After greening



School B: Baseline



School B: After greening



School C: Baseline



School C: After greening



School D: Baseline



School D: After greening



School E: Baseline



School E: After greening

Figure 1. Impressions of the schoolyards of the five intervention schools before greening at baseline (left) and after greening at follow-up (right)

Observations and coding of play behavior

Video-observations

At each participating school, during the 15-minutes morning recess of the children in grade 4, 5 and 6 (as classified by the Dutch educational system) the schoolyards were monitored by multiple video camera's capturing the whole area. We recorded between 15 and 45 minutes at each school, as at some schools there were two or three different periods of recess for children in different groups. Video-observations were made on one day during baseline in 2014 and on one day during follow-up in 2016. Observation days were chosen such that they would fall in approximately the same period each year to avoid nuisance caused by for instance seasonal influences, weather conditions and holidays. The video cameras were placed so that they would not hinder children's activities in the schoolyard.

Target areas

Each schoolyard was divided into target areas by the researchers. Target areas were selected based on pragmatic criteria to facilitate the coding of videotapes. Each target area was identified to cover a specific feature of the schoolyard, like for instance a soccer field or a climbing element. Target areas were chosen so that together the cameras placed in the area would cover the entire schoolyard. If needed, larger areas or features that were difficult to code from only one viewpoint were divided into more than one target area with multiple cameras to assure accurate coding. As the design of schoolyards changed between baseline and follow-up, the number of target areas differed between baseline and follow-up. At baseline 50 target areas were distinguished, while at follow-up 66 target areas were distinguished (see Table 1).

Table 1. Number of target areas, time frames and observations, and % boys at each time of measurement for both the total sample and for each school separately.

	Baseline				Follow-up			
	Target areas	Time frames	Observations	% Boys	Target areas	Time frames	Observations	% Boys
Total	50	3808	17046	55.78%	66	4428	13156	50.91%
school A	7	535	3721	54.47%	12	840	2085	53.81%
school B	11	591	3006	50.60%	12	777	2551	48.69%
school C	12	398	1744	45.47%	12	852	1468	31.00%
school D	7	458	3831	51.92%	13	871	3934	59.63%
school E	13	1826	4744	66.97%	17	1088	3118	49.42%

Coding of play behavior

Play behavior was coded using the Play Observation Scale (POS, Rubin, 2001). The POS was developed to assess social, cognitive play and non-play behaviors. For this study we only coded the cognitive play behavior and non-play behavior. Cognitive play behavior was divided into five categories of functional play, games-with-rules, and constructive, dramatic and exploratory play. Non-play behavior was divided into the following eight behaviors/activities: active conversation, onlooker, unoccupied, transition, rough-and-tumble, aggressive, interaction with camera, and interaction with teacher. See Table 2 for a brief description and examples of each of the play and non-play categories. Originally the POS was developed for on-site observation and employs a methodology that requires the observer to sample the behavior of one single child during a fixed period. However, in this project we had the opportunity to make video-observations, which can be paused, zoomed-in and rewinded for as many times as needed. This made it possible to code behavior of all children playing at a certain time in a certain area, instead of the behavior of only one single child.

Videotapes of the play behavior were coded by research assistants who were unaware of the aim of the research. Assistants were instructed to closely watch the children in time frames of 30 seconds and to register the most observed type of behavior of each child present during the 30 seconds. If necessary, they could stop the tape and zoom in or rewind. Due to the quantity of the recorded footage, it was not feasible to register all types of behaviors a child displayed in a time frame. However, in most time frames children engaged in the same type behavior during the entire 30 seconds, thus the most observed behavior was in most cases the only type of behavior. In time frames with different types of behavior, these behaviors usually differed in length, which made it clear which was the predominant type of behavior. In the few cases where behavior was too mixed to establish a clear predominant type of behavior, the time frame was labeled 'uncodable'.

Table 2. Description of sub-categories of the Play Observation Scale for the categories of cognitive play and non-play behavior.

Play behavior	
Functional	Simply repetitive muscle movements with or without objects – e.g. running, sliding, climbing.
Games-with-rules	Competitive game-type activities following established rules and limits, e.g. playing soccer or hide-and-seek.
Constructive	Activities to manipulate objects to construct or create something – e.g. creating a hut and shelters, playing with loose parts.
Dramatic	The substitution of reality with an imaginary situation – e.g. role play.
Exploratory	A focused examination of objects in the environment – e.g. detailed examination of snails.
Non-play behavior	

Active conversation	Communicating verbally with others.
Onlooker	Watching or listening to behaviors and activities of other children.
Unoccupied	Behavior with a lack of goal or focus – e.g., staring blankly into space, wandering with no specific purpose.
Transition	Preparing or setting out activity or moving from on activity to another.
Rough-and-tumble	Mock fighting or playful physical contact - e.g. tickling or wrestling.
Aggressive	Non playful agonistic interaction with another child – e.g. hitting, kicking, grabbing, etc.
Interaction with camera *	Children interacting with video cameras in the schoolyard
Interaction with teacher**	Children talking or otherwise engaged in interaction with teacher

*added given that we use video-observations instead of real-life coding ** added based on experiences during coding.

Reliability

The video data were coded by four pre-trained research assistants. Given the quantity of the recorded footage, it was not feasible to have all individual observations of play behavior coded by two independent observers. However, we took several steps to ensure inter-observer reliability. First, the coding scheme was tested together with students following an education program to become primary school teachers. Each student coded 15 minutes of video data of a target area using the POS. Afterwards similarities, differences and possible difficulties in coding the video-materials were discussed. Based on these discussions the protocol was amended with suggestions for how to deal with difficulties and ambiguities. Second, the research assistants were trained and undertook practice scans to ensure that there were no

considerable differences between the coding used by each research assistant. During coding, when confronted with a difficulty the research team watched the video together and decided on how to code the behavior. Last, during coding each research assistant made notes of the behavior they observed in children. For instance, that children were playing soccer or were talking with friends. These observations were used to control the data files as a final check to ensure that all categories were used in a similar manner by every observant.

Procedure

Each participating elementary school was visited for one school day at baseline and at follow-up. The chosen weekdays and sequence of visitation were equal for baseline and follow-up measurements. The research team visiting the schools consisted of three researchers, accompanied by ten students (with a background in teacher training, psychology, or health sciences). Prior to data collection, students were trained to ensure an adequate understanding of the method of data collection. A data collection protocol was developed to minimize nuisance due to differences in data collection and therewith increase the reliability and validity of the findings. This protocol contained detailed information about the placement of the camera's and accompanying instructions. During the 15-minutes morning recess each camera was guarded by a researcher or student, who put it in the right position, pressed the start and stop button to start recording, and while the camera was filming made sure that the children did not touch the equipment. At the end of each school visit the cameras were collected by one researcher who transferred the digital recordings to a secured hard-drive only accessible by researchers. Afterwards, the cameras were reset, brought back to the university and stored in a locked room.

Data analysis

Video-recordings from each target area (with a total length of about 32 hours at baseline, and 37 hours at follow up) were divided in equal time frames of 30 seconds, during which the behaviors of all children in the area were coded. As shown in Table 1, this yielded a dataset of 17046 observations of children in 50 target areas at baseline, and 13156 observations of children in 66 target areas at follow-up. Chi-square statics were used to test the impact of greening schoolyards on observations of children's play and non-play behavior. Several contingency tables were constructed with baseline and follow-up as rows and play and non-play behaviors as columns. We constructed a 2x2 table to test the impact of greening on play versus non-play behavior, a 2x5 table to test the impact of greening on the five cognitive play categories and a 2x8 table to test the impact of greening on the eight non-play categories. In addition, for each separate play and non-play category we constructed 2x2 tables to test the impact of greening on the specific category of behavior. All contingency tables and Chi-square statistics were calculated for the overall sample, as well as separately for boys and girls. From the contingency tables we derived percentages to describe the proportions of total observed play and non-play behavior, as well as the observed proportions within each sub-category, for the total sample and separate for boys and girls.

Results

Table 3 provides an overview of observed percentages of play and non-play behaviors at baseline and follow-up as well as a summary of tests results for the overall sample and for boys and girls separately.

Table 3. Percentages of observed play behavior and non-play behavior at baseline and follow-up and the comparison of proportions (chi2) between baseline and follow-up percentages for the total sample, and separate for girls and boys.

	Total						Girls						Boys						
	Baseline		Follow-up		Chi ²	p	Baseline		Follow-up		Chi ²	p	Baseline		Follow-up		Chi ²	p	
Play																			
Functional	21.34%	19.34%	18.20	<.001	25.35%	21.52%	28.28	<.001	18.17%	17.25%	0.13	ns	40.85%	38.39%	9.95	<.01			
Games-with-rules	30.06%	35.58%	103.23	<.001	16.45%	32.67%	502.72	<.001	0.27%	3.61%	269.49	<.001	0.03%	1.60%	142.95	<.001			
Constructive	0.53%	2.09%	151.80	<.001	0.85%	0.51%	5.78	<.05	0.64%	0.87%	0.10	ns	59.97%	61.71%	5.03	<.05			
Exploratory	0.10%	1.73%	246.18	<.001	0.19%	1.87%	103.73	<.001	0.81	0.87%	0.10	ns	59.97%	61.71%	5.03	<.05			
Dramatic	0.93%	1.10%	0.14	ns	1.30%	1.35%	0.81	ns	0.64%	0.87%	0.10	ns	59.97%	61.71%	5.03	<.05			
Total	52.96%	59.85%	142.97	<.001	44.13%	57.92%	264.58	<.001	59.97%	61.71%	5.03	<.05	59.97%	61.71%	5.03	<.05			
Non-play																			
Active conversation	15.10%	7.03%	472.01	<.001	22.06%	9.27%	419.68	<.001	9.58%	4.87%	123.86	<.001	10.56%	3.18%	308.08	<.001			
Onlooker	10.94%	4.08%	477.21	<.001	11.42%	5.02%	184.13	<.001	0.97%	5.93%	330.33	<.001	14.57%	19.44%	67.46	<.001			
Unoccupied	1.09%	6.95%	725.61	<.001	1.25%	8.00%	380.53	<.001	1.30%	1.91%	9.56	<.01	0.15%	0.07%	1.77	ns			
Transition	15.40%	18.12%	39.75	<.001	16.45%	16.75%	0.63	ns	1.15%	1.37%	0.20	ns	1.76%	1.51%	0.22	ns			
Rough-and- tumble	0.99%	1.31%	6.94	<.01	0.60%	0.70%	0.46	ns	40.03%	38.29%	-	-	40.03%	38.29%	-	-			
Aggressive	0.11%	0.07%	0.28	ns	0.05%	0.06%	0.83	ns	40.03%	38.29%	-	-	40.03%	38.29%	-	-			
Camera interaction	1.19%	1.19%	0.95	ns	1.23%	1.01%	0.20	ns	40.03%	38.29%	-	-	40.03%	38.29%	-	-			
Teacher interaction	2.22%	1.39%	28.17	<.001	2.81%	1.27%	40.25	<.001	40.03%	38.29%	-	-	40.03%	38.29%	-	-			
Total	47.04%	40.15%	-	-	55.87%	42.08%	-	-	40.03%	38.29%	-	-	40.03%	38.29%	-	-			

Play versus non-play behavior

After greening, there is a significant increase of 6.9% in the percentage of observed play behavior in children from 53.0% at baseline, to 59.9% at follow-up. The impact of greening schoolyards differed for boys and girls and appeared to be larger for girls. As illustrated in Figure 2, at baseline the percentage of observed play behavior is 15.8% higher in boys compared to girls, $\text{Chi}^2(1) = 423.25, p < .0001$. After greening, the observed percentage of play behavior in girls increased significantly with 13.8%, from 44.1% to 57.9%. Whereas the observed percentage of play behavior in boys slightly increased with 1.7%, from 60.0% to 61.7%. As a result, after greening for both boys and girls the predominant behavior during recess in the schoolyard is play behavior. Although the difference between boys and girls decreased at follow-up, the percentage of observed play behavior is still 3.8% higher in boys compared to girls, $\text{Chi}^2(1) = 19.71, p < .0001$.

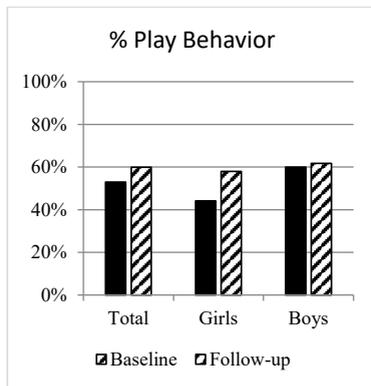


Figure 2 Percentages of observed play behavior in the schoolyard for the total sample, girls and boys at baseline and follow-up.

The impact of greening on type of play behavior

After greening the distribution of observed behavior across categories of play behavior significantly changed, $\text{Chi}^2(4) = 412.49, p < .0001$. As illustrated in Figure 3, at baseline the dominant play categories are functional play (21.3%) and games-with rules (30.1%). Constructive (0.5%), exploratory (0.1%) and dramatic (0.9%) play behavior was hardly observed. The overall increase in observed play behavior after greening is characterized by a significant increase of 5.5% in the observed games-with-rules, an increase of 1.6% constructive play and an increase of 1.6% in exploratory play behavior. In addition, an increase of 2.0% in functional play behavior was observed. Greening had no impact on observed dramatic play behavior. Despite the increase in exploratory and constructive play behavior after greening, the dominant play categories at follow-up remain functional play (19.3%) and games-with-rules (35.6%).

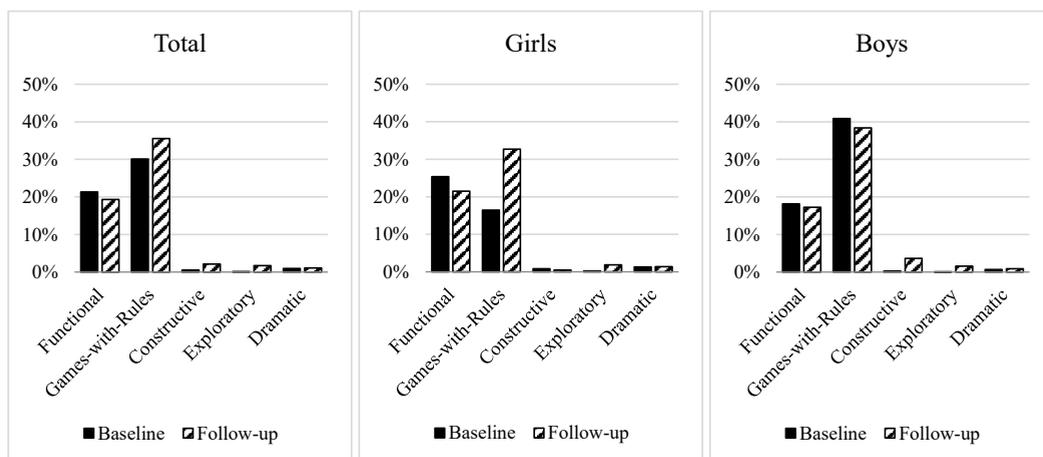


Figure 3 Percentages of observed play behavior in the schoolyard for each of the play categories for the total sample, girls and boys at baseline and follow-up.

Gender differences

The distribution of observed behavior across categories of play behavior changed for both boys, $\text{Chi}^2(4) = 413.609, p < .0001$ and girls, $\text{Chi}^2(4) = 380.60, p < .0001$. However, changes were more noticeable in girls than in boys. As illustrated in Figure 3, at baseline the most frequently observed play category for girls is functional play (25.4%) followed by games-with-rules (16.5%), whereas after greening this order is changed with games-with-rules (32.7%) being the most frequently observed category. Games-with-rules is the most frequently observed play category for boys at both baseline (40.9%) and follow up (38.4%), although the relative frequency of both play behaviors compared to other behaviors is reduced at follow up. Furthermore, both girls (1.7%) and boys (1.6%) show a significant increase in observed exploratory play behavior from baseline to post-greening. In addition, boys show a significant 3.3% increase in constructive play, whereas girls show a small 0.3% decrease in constructive play behavior. As a result, after greening the dominant observed play behavior in both girls (32.7%) and boys (39.4%) is games-with rules. Greening had no significant impact on dramatic play behavior of boys or girls.

The impact of greening on type of non-play behavior

After greening the distribution of observed behavior across categories of non-play behavior significantly changed, $\text{Chi}^2(7) = 1586.08, p < .0001$. As illustrated in Figure 4, at baseline the most frequently observed non-play categories are active conversation (15.1%) and transition (15.4%), followed by onlooker (10.9%) non-play behavior. The decrease in observed non-play behavior after greening is characterized by a significant 8.1% decrease in observed active conversation, a 6.9% decrease in onlooker behavior, and a 0.8% decrease in teacher interaction non-play behavior. Furthermore, although the overall observed non-play behavior decreased, there is a significant 5.9% increase in observed unoccupied, a 2.7% increase in

transition behavior, and a small 0.3% increase in rough-and-tumble non-play behavior after greening. As a result, at follow-up the most observed non-play category is transition (15.4%), followed by unoccupied (7.0%) non-play behavior and active conversation (7.0%) non-play behavior. Greening did not have significant impact on observed aggression and interaction with camera.

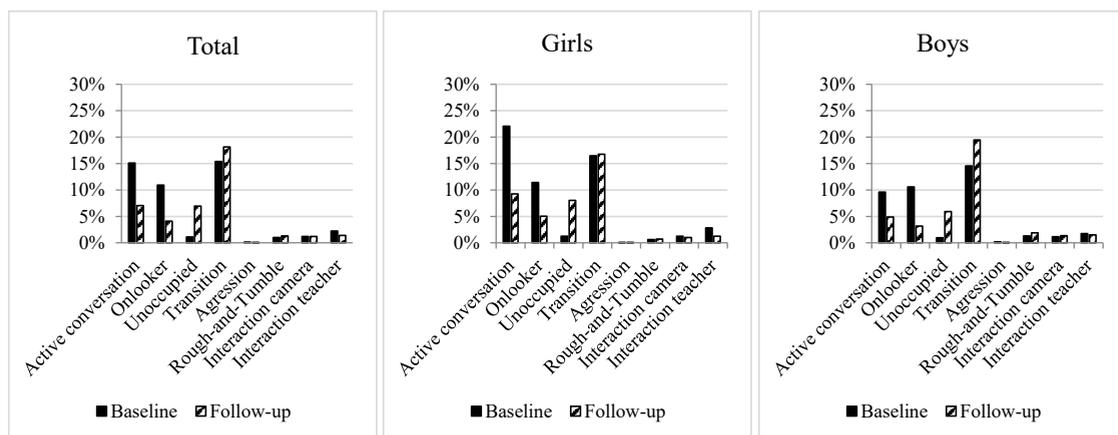


Figure 4 Percentages of observed non-play behavior in the schoolyard for each of the non-play categories for the total sample, girls and boys at baseline and follow-up.

Gender differences

The distribution of observed non-play behavior significantly changed after greening for both boys, $\text{Chi}^2(7) = 793.60, p < .0001$, and girls, $\text{Chi}^2(7) = 826.19, p < .0001$. As illustrated in Figure 4, for girls the most observed non-play category before greening is active conversation (22.1%), followed by transition (16.5%) and onlooker (11.4%) non-play behavior. For boys, before greening, the most observed non-play category is transition (14.6%), followed by onlooker (10.6%) and active conversation (9.6%) non-play behavior. After greening, active conversation was decreased in both girls (12.8%) and boys (4.7%), and onlooker behavior was also decreased in both girls (6.4%) and boys (7.4%). In addition, girls showed a significant

1.5% decrease in the percentage of observed teacher interaction after greening. Although overall the observed non-play behavior decreased for both girls (6.8%) as well as boys (5.0%), girls showed a significant increase in the percentage of unoccupied behavior after greening. Furthermore, boys showed a significant 4.9% increase in the percentage of observed transition non-play behavior after greening, and a small 0.6% increase in rough-and-tumble behavior. As a result, after greening the dominant observed non-play behavior in both boys and girls is transition, followed by active conversation and unoccupied non-play behavior.

Discussion

In this study we compared children's video-taped play and non-play behavior during recess before and after the greening of their schoolyards. Results support the hypotheses that greening schoolyards stimulates more play, as compared to non-play, behavior, as well as more varied, constructive, and exploratory play behavior. After greening the percentage of observed play-behavior increased at the cost of non-play behavior. This increase was largely due to an increase in games-with-rules and a small increase in exploratory and constructive play behavior. Although greening stimulated children to engage in more varied, constructive and exploratory play behavior compared to their behavior on the previously paved schoolyards, the dominant play behavior after greening remains games-with-rules and functional play behavior on the green schoolyards. Contrary to our hypotheses, we were unable to detect any impact of greening on dramatic play behavior. The decrease in non-play behavior was largely due to decreases in active conversation and onlooker behavior. However, we also observed increases in unoccupied and transition behavior.

The finding that after greening the prevalence of constructive and exploratory behavior slightly increased, is in line with the assumption that greening schoolyards creates a more fascinating, unpredictable and flexible environment that affords more creative and exploratory

play behavior compared to paved schoolyards (Dyment & Bell, 2007b; Kuh et al., 2013). However, children still predominantly preferred functional play and games-with-rules in their new green schoolyard. Although we expected to find a more substantial change in the variation of play behavior, our findings do coincide with previous studies. For instance, Mårtensson et al. (2014) also found that green schoolyards stimulate more varied and creative play behavior, but in particular more games-with-rules. They describe how children in their study enjoy to explore, run and play hide and seek and chasing games on different surfaces, structures and routes that are created on the green schoolyard. Fjørtoft (2004) observed functional play to be the dominant type of play displayed by pre-school children playing in a forest area near a schoolyard. Greening thus seems to create a schoolyard that, compared to a paved schoolyard, to a greater extent affords children to actively run and play during recess, but stimulates creative and exploratory play behavior to a limited extent.

One explanation for why we did not find a more substantial increase in creative play behavior could lie in the design of the green schoolyards in this study. The green schoolyards in our study are somewhat richer in affordances and loose parts compared to the previously paved schoolyard, but loose parts were hardly present in the greened schoolyards. According to the theory of loose parts, it is especially the loose parts like branches, sand and leaves that stimulate creative play behavior (Nicholson, 1972). At a closer look, most natural features in the schoolyards of participating schools are constructed by landscape architects and are constructed of but not rich in loose parts like branches, twigs, stones and sand that allow children the opportunity to design, re-design and give meaning themselves. Furthermore, drawing conclusions based on the taxonomy of functional affordances of Heft (1988), the extent to which greening schoolyards rigorously altered the richness in affordances can be questioned. Moreover, there are barely any opportunities that could inspire children to build or explore themselves. An example, for instance, is the presence of a treehouse. When asked beforehand

what most children would prefer to have if their schoolyard is going to be greened, often children express the wish for a treehouse (Maas et al., 2014). So, on most green schoolyards architects design and build a treehouse. However, the question is whether this is actually what the children had in mind. Did they wish to have a treehouse or did they wish to build a treehouse themselves? In these situations, according to Nicholson (1972) children are 'trapped in the beauty of the design'. It is the architect who has all the fun of being creative and designing with natural loose parts and not the children.

With respect to children's non-play behavior, the increase in unoccupied behavior could indicate that some children cannot find their way on the new green schoolyard, and feel somewhat lost. However, it could also suggest a different interpretation of behavior that was coded as unoccupied. Unoccupied could indicate that children are bored or feel lost, but it could also indicate that children are purposely on their own for a while, wandering around and relaxing. In the early years of environmental research, Hart (1979) already described how children were spending time alone, quietly resting in natural areas. In a similar vein, Chawla et al. (2014) show that children describe a green area in their schoolyard as a place where they feel at peace, do not feel worried and where they can be alone for a while. Furthermore, Dymnt and Bell (2008) not only found that green schoolyards stimulate a greater diversity in play activities, but also more freedom to wander around and lie down in contrast to only promoting physically active play. In a similar vein, Woolley and Lowe (2013) found green playgrounds to have a greater play value compared to paved playgrounds, but also found more children being on their own on green playgrounds compared to paved playgrounds. They suggest that green playgrounds offer more private places for children to spend some time being unoccupied. Greening schoolyards, thus seems to create an environment that affords active play behaviors as well as greater opportunities to find some time to wander around and be on your own. In this light, being unoccupied could indicate that some children need to be alone for a while during

recess and that greening schoolyard affords the opportunity for children to fulfill this need. This assumption receives some support from previous research regarding restorative experiences in nature (Staats & Hartig, 2004). This research suggests that restoration from mental fatigue can be enhanced if participants spent time walking alone in nature instead of walking with company, as long as safety is warranted.

There were some noticeable differences in the impact of greening between girls and boys. Before greening, girls mostly engaged in non-play behavior, like conversations and watching boys playing soccer, whereas boys mostly engaged in soccer and other games-with-rules. After the schoolyards were greened, the dominant behavior in girls switched from non-play to play behavior, mostly games-with-rules. So, after greening both girls and boys spent most of their time during recess in play behavior. These findings support the expectations, as drawn from Affordance Theory (Gibson, 1979), that greening creates a multi-dimensional schoolyard that hold numerous affordances and is better accommodated to the interests, abilities and needs of all children. The findings are also in line with previous studies, which describe green areas in schoolyards to be more sensitive to the needs of both girls and boys (Dyment & Bell, 2008; Lucas & Dyment, 2010). Green schoolyards tend to be designed with diverse infrastructures that afford girls to be less passive and more actively engaged in play behavior themselves (Mårtensson et al., 2014; Mitchell, Tillmann, & Gilliland, 2018). In paved schoolyards girls can be systematically excluded from space and play opportunities on paved schoolyards by boys who dominate the schoolyard with their games (Sharma-Brymer & Bland, 2016).

For boys, the most notable effect of the greening was that they showed an increase in transition non-play behavior after the schoolyards were greened. The increase in transition behavior could indicate that boys' play behavior became more interrupted after greening, shifting from one activity to another. This would contradict previous literature which suggests

that playing in nature evokes a deep attention, which brings children in an endless flow of play (Chawla et al., 2014; Luchs & Fikus, 2013). However, it is also plausible that the increase in transition indicates that boys were transferring across the green schoolyard as a whole during their play activities. For instance, boys were observed running from one area in the schoolyard to another, to continue with their play behaviors. This explanation is in line with Kuh et al. (2013), who explored the impact of greening as part of a 'lab schoolyard' on children's play behavior. They observed that after the green intervention was implemented, children developed play scenarios that required them to move materials from one part of the schoolyard to another, and did not limit play themes to a particular area. In particular, nature-based features like hills with several routes could have afforded these types of transition behaviors. Another possible explanation for transition behaviors in boys could be the more cohesive designs with play routes across the different parts of the schoolyard, after greening. To a certain extent the label of transition as non-play may be misleading. During some transitions boys were observed setting up a game, negotiating and waiting for friends to join their game.

Limitations and suggestions for future research

The present study addresses many of the shortcomings of previous research on the impact of greening schoolyards on school children's play behavior by employing an intervention based design and with pre- and post-measures of coded video-observations of all children's behavior in the schoolyard, instead of interviews and questionnaires, or on-site observation with only pre-selected individual children. However, the research is not without limitations.

First, although video-observations opened up opportunities to observe the behavior of all children in the entire schoolyard, in some occasions a target area was densely crowded with children and this made coding more difficult. In particular when the camera was standing a bit

further away from the target area, observers sometimes found it difficult to distinguish boys from girls and code the play behavior. As a solution, some target areas were afterwards changed and diverted into smaller target areas to support accurate coding. In addition, observers could pause, zoom in and rewind the video observations and negotiate their observations with other observers.

Second, the POS provides a comprehensive coding scheme to observe social play of children by coding whether a child plays alone, parallel to other children or in a group. Due to our limited resources and the immense amount of time it takes to code video-observations we could only code the play and non-play behavior of children. As a result it was not possible to test for impacts of schoolyard greening on social behavior, which have been reported in previous research (Dowdell, Gray, & Malone, 2011; Seeland, Dübendorfer, & Hansmann, 2009).

Third, target areas were selected to cover specific features of the schoolyard. However, children's play behavior is not restricted to a target area and we could not follow individual children in their play across the target areas. As we were interested in the behavior of all children in the schoolyard as a whole, we did not follow the behavior of individual children nor explicitly observed children transferring their play across target areas. However, we did observe transition behaviors of children within target areas, and children leaving target areas. As we found an increase in transition behavior after greening, future research might further investigate how greening affects children's play patterns across different areas in the schoolyard.

Fourth, this research used a pre-post design only, without observations at control schools that did not green their schoolyard. Due to this lack of control groups it cannot be excluded that the changes in play and non-play behavior are the result of factors unrelated to the greening of the schoolyard, like educational developments, maturation of children or incidental changes of the schoolyard. However, such an explanation seems unlikely given that we included five

different primary schools, and conducted the pre- and posttests among children in the same age groups.

Fifth, data collection at baseline and follow-up was restricted to one day a year at each school. This makes observations sensitive to the influence of weather conditions, novelty effects, coincidence of time, or extra-ordinary events during recess or in the classroom. However, video-observations were carried out in approximately the same period at each school every year, researchers consequently followed a strict protocol, and special events were avoided.

Last, a major limitation of the present research is that as researchers, we had no experimental control over the design of the greening. Although all intervention schools had plans to substantially green their schoolyards, the quality and quantity of natural features were modest in some cases and all green schoolyards still contained substantial paved areas. In particular, it is questionable whether the green schoolyards were designed with sufficient natural loose parts that afford children to engage in creative and exploratory play behavior. This may have influenced our results, possibly leading to an underestimation of the impact of greening schoolyards on children's play behavior.

That the design of a green schoolyard can be disappointing, is also shown by a study amongst two Swedish schools in which children were interviewed and observed during the transition of a part of their schoolyard into a green area (Jansson, Mårtensson, & Gunnarsson, 2017). Children in this study were not unanimously positive about the green area, because the green area was not what the children had asked for during the design process and had imagined it to be. In addition, they observed a greater variation in behavior after the greening was completed, but not necessarily more creative play behavior. In particular during the first years after greening, the green area was not always well developed and had insufficient qualities to attract children's attention. In a similar vein, other studies show that children find green areas

in their schoolyard attractive, but do not necessarily use these areas for play (Andersen, Klinker, Toftager, Pawlowski, & Schipperijn, 2015; Mårtensson et al., 2014). Previously we showed that the children in our project did find their new green schoolyard somewhat more attractive than their previously paved ones, but they were not overly positive and there is still room for improvement (Van Dijk-Wesselius et al., 2018).

In this light, it is important for schools and landscape architects to be aware of the risk of designing a green schoolyard that looks more attractive, but does not greatly differ in terms of affordances and the presence natural features that are open and flexible, unpredictable and draw children into a creative engagement with the environment. Introducing more loose parts to the designs of green schoolyards could be a promising intervention to further stimulate constructive and exploratory play. That introducing loose parts might increase children's constructive and creative play is, for instance supported by Engelen et al. (2017). They showed that introducing loose parts, like natural features and recycled materials to a schoolyard stimulated an increase in constructive and creative play behavior. However, understanding the mechanisms and opportunities of loose parts needs further exploration (Gibson, Cornell, & Gill, 2017). Future research could benefit from the development of a tool to indicate the greenness and play value of a green schoolyard. This tool could support the design of green schoolyards and the explanation of research findings.

Conclusion and implications

By demonstrating that greening schoolyards promotes play in general, and more varied and inclusive play in particular, the present research strengthens schools in taking upon the initiative to green their schoolyards. It highlights the challenge to design green schoolyards that foster opportunities for all children to engage in the type of behavior they need, whether it is being physically active, creative, talking to a friend, being passionate about a game or

wandering around and finding a place to relax. Future research could replicate and extend our approach, to further investigate the optimal aspects for designing such an inclusive green schoolyard. Furthermore, we would advise researchers and schools to co-work in designing green schoolyards and develop a tool to indicate greenness and play value of schoolyards. In addition, collaboration may increase the time and funding available to expand data collection to more than one day a year and follow the individual trajectories of children across areas in the schoolyard.

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4

Chapter 4

Parental Perspectives on Greening Schoolyards: Advantages Outweigh Disadvantages, but Willingness to Help is Limited

This chapter is based on Van Dijk-Wesselius, J.E., Hovinga, D., De Koning, M.,
Maas, J. & van den Berg, A.E. (2020).

Parental perspectives on greening schoolyards. Advantages outweigh
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Abstract

Parental involvement is critical to the successful implementation of green schoolyards. This paper reports results from two surveys that asked a total of 402 parents of children in schools with green and paved schoolyards about their appreciation of the schoolyard, children's behavior in the schoolyard, (dis)advantages of a green schoolyard, and willingness to become involved. Parents from schools with a green, compared to a paved, schoolyard showed higher appreciation of the schoolyard and more often reported that the schoolyard supports varied play and other behaviors. Parents generally saw more advantages than disadvantages of a green schoolyard, and many parents indicated that disadvantages, such as children coming home dirty, are not very important to them. Parents wanted to be involved in designing a green schoolyard and with schoolyard activities. However, they were less willing to help with maintenance, and their time to help is limited.

Keywords: Schoolchildren, elementary schools, natural play, parental views, restorative environment, sustainable schoolyards

A movement to green schoolyards and reconnect children to nature is gaining momentum around the globe, weaving the ideas of urban sustainability and ecological design together with children's well-being, healthy development, academic achievement, and community engagement (Danks, 2010; Dymont & Green, 2018). This movement is primarily driven by concerns about children's decreasing contact with nature. This disconnection of children from nature has been related to factors such as urbanization, parental concerns about dangers from traffic and strangers, and children's screen-based lifestyle (Tanja-Dijkstra, Maas, Van Dijk-Wesselius, & Van den Berg, 2019; Veitch, Salmon, & Ball, 2010). Greening schoolyards provides a unique way to reconnect children with nature, since schoolyards are among the few places where children from all backgrounds can go and play freely (Raith, 2018). Despite the many benefits of green schoolyards, schools often struggle with parental support and collaboration (Redman, 2013). Since parental involvement is an important success factor for the realization and maintenance of green schoolyards, the current article focuses on gaining insight in parental perspectives on green schoolyards.

Green schoolyards are schoolyards with natural elements (such as shrubbery, trees, flowers, sand, water, grass hills) where children are invited and encouraged to interact, play and learn in and with nature. An increasing body of research shows support for the beneficial impact of green schoolyards for children's well-being and development (Bates, Bohnert, & Gerstein, 2018; Van Dijk-Wesselius, Maas, Hovinga, Van Vugt, & Van den Berg, 2018). Previous studies indicate that green schoolyards are appreciated by children (Maas, Tauritz, van der Wal, & Hovinga, 2013; Samborski, 2010), stimulate physical activity (particularly in girls) (Coen, Mitchell, Tillmann, & Gilliland, 2019; Mårtensson et al., 2014; Pagels et al., 2014), foster varied and creative play behavior (Fjortoft, 2004; Malone & Tranter, 2003), enable children to escape from stress (Bagot, Allen, & Toukhsati, 2015; Chawla, Keena, Pevec, & Stanley, 2014) and support building social relationships (De Vries, Langers, Donders, Willeboer, & Van Den

Berg, 2013; Maas et al., 2013). Furthermore, green schoolyards offer opportunities to stimulate environmental awareness in children (Bentsen, Mygind, & Randrup, 2009).

A green schoolyard thus seems to be a promising enrichment for primary schools. However, realization and maintenance of a green schoolyard costs time, money and energy. Several evaluations of schools' experiences with greening schoolyards show that, on the 'road to success', parental involvement is an important factor (Maas, Muller, & Hovinga, 2014; Redman, 2013; Van Nispen tot Pannerden, Tegels, & Van Laar, 2014). These reports suggest that a good connection and communication with parents during and after construction could prevent conflict, minimize concerns about safety and dirty clothes, and stimulate willingness to help with the maintenance of the schoolyard.

In general, parental involvement can be difficult to realize. There are differences between parents in their needs, barriers and ideas on how they can and wish to be involved (Crozier & Davies, 2007). Furthermore, parental involvement can be challenged by a dominant vision of schools thinking mostly from their own perspective on how parents can serve the school's agenda (Pushor & Amendt, 2018). In this perspective, parents can be labelled as hard to reach or difficult to motivate if they do not comply with the school's proposed practices.

Although schools generally acknowledge that parental involvement is important for a successful implementation of a green schoolyard, little is known about how parents view the (green) schoolyard and how they want to be involved. This lack of knowledge may cause a gap between the assumptions of primary schools and parents' actual views. Such a gap could lead to ineffective attempts of schools to involve parents (Hornby & Lafaele, 2011). In general, an open disposition towards parental views and beliefs may not only help schools in determining an appropriate starting point for collaboration, but also provide notions on what to emphasize, which pitfalls to anticipate and how to properly steer the process (cf. Pushor & Amendt, 2018).

The present study aims to gain more insight into parental perspectives on green schoolyards. More specifically, this study aims to (1) compare how parents (including caregivers) from schools with green and paved schoolyards evaluate their schoolyard in terms of general satisfaction, behaviors supported by the schoolyard, and problems related to dirt and safety, (2) examine parental views on advantages and disadvantages of a green schoolyard, and whether these views differ between parents who have experience with a green schoolyard and parents who do not have such experience, and (3) assess parents' preferences regarding how they want to be involved in green schoolyards, and their willingness to become involved.

Method

Schools and schoolyards

This study uses data from two surveys among parents and caregivers from schools with green and paved schoolyards. The first survey was conducted in 2012 among parents of schools in the Dutch town of Helmond as part of a larger study on green school yards. Four schools were included in the present analysis, of which one had two schoolyards, leading to a total of five schoolyards. Two of the five schoolyards were green schoolyards and three were predominantly paved with tiles. At the time of the survey, one of the green schoolyards had been recently greened, the other one had been greened for many years. The size of the five schoolyards included in the study varied between 480m² and 5000m², and on average, the two green schoolyards were larger (3800m²) than the three paved schoolyards (1784m²).

The second survey was conducted in 2015 among parents of schools in the Western part of The Netherlands as part of a larger study on greening schoolyards. Ten schools were included in the present analysis, of which six had a green schoolyard and four had a paved schoolyard. At the time of survey, all green schoolyards had been recently greened in the past five years.

The size of the schoolyards varied between 422m² and 1660m², and on average the six green schoolyards were larger (1046m²) than the four paved schoolyards (736m²).

All schools in both studies were located in moderate (1000-1500 addresses per km²) to highly urbanized areas (1500+ addresses per km²). According to the Netherlands Bureau of Statistics, more than half of the inhabitants of the Netherlands live in such areas, which makes the sample relevant for a large part of Dutch society.

Respondents

Table 1 summarizes the core demographics of the respondents in the two studies. The first survey comprised 137 parents and caregivers (83.9% female) of children in grades 4-6 (ages 7-11, 49% girls) of which 45.9% were from schools with a green schoolyard. The second study comprised 265 parents and caregivers (79.2% female) of children in grades 4-7 (ages 7-11, 52% girls) of 10 elementary schools of which 52.8% were from schools with a green schoolyard. In both studies, a majority of the respondents were highly educated and had a paid job. Parents from schools with paved and green schoolyards had a similar socio-demographic profile. However, in Study 2 parents from schools with a green schoolyard were more often female than parents from schools with a paved schoolyard, and they were also relatively highly educated. Parents in Study 1 reported on younger children than parents in Study 2. However, within each study, there were no differences between green and paved schoolyards in the age of children that were included in the questionnaires.

Table 1: Sample characteristics.

	Study 1		Study 2	
	Paved (<i>N</i> = 74)	Green (<i>N</i> = 63)	Paved (<i>N</i> = 125)	Green (<i>N</i> = 140)
Age, in years, <i>M</i> (<i>SD</i>)	39.3 (4.2)	40.9 (4.3)	40.7 (5.6)	42.4 (4.3)
Female	85.1%	82.5%	78.4%	88.1%
High education level	62.2%	60.3%	65.6%	75.7%
Paid job (> 12 hrs p/w)	68.9%	77.8%	73.6%	82.1%
Gender of child (% girl)	45.9%	51.6%	52.0%	52.2%
Age of child, in years, <i>M</i> (<i>SD</i>)	7.96 (0.9)	7.90 (0.9)	8.88 (1.0)	8.66 (1.0)

Questionnaires

Two separate questionnaires were developed for the two studies, tailored to the specific context and interests of the schools. A subset of questions from the original questionnaires was used in the current analysis. For both studies, this selection included similar, but differently phrased, questions about parents' appreciation of the schoolyard, children's play behavior, and issues related to safety and dirt. Additional open-ended questions about the advantages and disadvantages of a green schoolyard were selected from the questionnaire of Study 1, while additional questions about parents' involvement in greening the schoolyard and their willingness to help were selected from the questionnaire of Study 2.

Both questionnaires were part of larger research projects in which impacts of green schoolyards were measured in various ways, ranging from children's self-reports to objective video observations and tests, and teachers' evaluations. The selection of outcome measures for these research projects was based on a combination of theoretical insights and practical considerations which are beyond the scope of the present article. The questions for parents were derived from the measures used among children and teachers, to obtain an inclusive and comparable perspective on the - real and perceived - benefits of green schoolyards.

Appreciation. The questionnaires included three questions about the appreciation of the schoolyard. First, parents in Study 1 were asked to answer to the statement ‘I am satisfied with the schoolyard’ on a Likert scale ranging from 1=‘completely disagree’ to 5=‘completely agree’. Second, parents in Study 2 were asked ‘How would you grade the schoolyard’ on a scale from 1-10. Parents in Study 2 also evaluated the schoolyard on a 5-point semantic differential scale that included the items: unnatural/natural, boring/adventurous, ugly/beautiful, not a nice place/nice place, not a nice atmosphere /nice atmosphere, not fun /fun, unsafe/safe, and dirty/clean. An exploratory factor analysis with varimax rotation yielded a clearly interpretable 2-factor structure that accounted for 73.3% of the variance. The first factor ‘Atmosphere’ accounted for 55.5% of the variables and includes six items: the schoolyard is a nice place, has a nice atmosphere, is adventurous, fun, beautiful and natural (Cronbach’s alpha = .91). The second factor ‘Clean and safe’ accounted for 17.8% of the variance and included the two items on cleanness and safety of the schoolyard (Cronbach’s alpha = .67). Scores on the two factors were calculated as the average of the scores on individual items.

Behavior in the schoolyard. Questions on children’s behavior in the schoolyard were derived from validated taxonomies of children’s play behavior, such as the Play Observation Scale (Rubin, 2001). Parents in Study 1 were asked to indicate on a 4-point scale (1 = never; 2 = almost never, 3 = sometimes; 4 = often) the occurrence of four types of behaviors in the schoolyard: (a) children playing together; (b) physical activity of girls; (c) physical activity of boys, and (d) conflicts.

Parents in Study 2 were asked to indicate on a 4-point scale (1 = completely not true; 2 = not true; 3 = true; 4 = completely true) the degree to which the schoolyard supports six types of behavior, clustered in three categories: (a) social play - play together, learn to act responsibly to each other; (b) active and varied play -engage in physical activity, play diverse games; (c)

environmental behavior - learn about nature, learn to act responsibly to their environment. There was also an answer option ‘I cannot estimate this’. Respondents who chose this last option (N ranging between 2.0% and 16.3% for the various behaviors) were excluded from the analyses. Parents also rated the importance of the different types of schoolyard behavior on a 3-point scale (1= no, 2 = a little, 3 = yes). Scores for each of the three behavioral categories were calculated as the average of the scores on the two individual items.

Safety and dirt. To assess parental experiences with safety, parents in Study 1 were asked to answer the questions ‘How often do problems at the schoolyard occur due to a lack of a clear view?’ and ‘How often do accidents occur at the schoolyard?’ on a 5-point scale ranging from 1= never to 5= often.

Parents in both studies were asked how often they have experiences with children becoming dirty at the schoolyard, with response options ranging from 1 = never to 5 = always in Study 1, and from 1 is never to 7 = always in Study 2. In both studies parents were also asked whether they mind if their child comes home dirty, with response options yes/no in Study 1 and yes/a little bit/no in Study 2.

Advantages and disadvantages of green schoolyards. The questionnaire of Study 1 contained two open-ended questions that asked parents to write down, in their own words, the advantages and disadvantages of a green schoolyard.

Involvement. Parents in Study 2 at schools with a green schoolyard were asked several questions about their involvement in greening the schoolyard. First they were asked how parental involvement in designing the new schoolyard was organized at their school, with response options ‘all parents had a direct voice’, ‘only through the parents advisory council’,

‘only through a select group’, ‘no involvement’ and ‘otherwise, namely ...’. Parents were also asked to select their preferred type of involvement from these options. Two other questions asked parents how often they would be willing to help with (a) activities at the green schoolyard, like festivities and lessons, and (b), the maintenance of the green schoolyard, with response options 1 = never, 2 = once per year, 3 = once per half year, 4 = once every four months, 5 = monthly, 6 = weekly. In addition they were posed the open-ended question ‘What withholds you from involvement in activities and maintenance at the green schoolyard?’

Procedure

In Study 1 data were gathered by giving the children who participated in the study a paper questionnaire in an envelope and asking them to hand it to their parents. No stamp was needed for sending it back. The questionnaire was distributed in September 2012 and had a response rate of 49.4%.

In Study 2 first a link to an online questionnaire was included in the newsletter parents receive weekly from their school. Because the response rate remained low (12.0%), a paper questionnaire was distributed in the same way as in Study 1. This increased the response rate to 33.0%. Data were gathered from July 2015- July 2016.

In the introduction of both questionnaires, the aims and background of the study were explained, and it was stressed that participation was anonymous and voluntary. After this introduction, parents could indicate their consent by adding their signature.

Analysis

Data were analyzed using SPSS version 24. One-way ANOVA was used to test for differences in appreciation of the schoolyard between parents from schools with green and

paved schoolyards. For single items measured at 4- or 5-point scales with approximately equal intervals between points we first ran equivalent nonparametrical tests to confirm that the outcomes were similar to those of the ANOVA. Differences in categorical items were analyzed using Chi-square tests. Answers to the open ended questions on (dis)advantages were analyzed with a grounded theory approach. Grounded theory research involves inductive and deductive cycles (Miller & Kuhaneck, 2008). Our analysis started with open coding; reading the answers and writing down the themes that were addressed in a few words. These themes were then compared in search for umbrella themes and subthemes. For each (sub)theme, the percentage of parents that mentioned an advantage or disadvantage in this theme was calculated. Since one answer may fit under several themes, total percentages can exceed 100%.

Results

Differences between schools with green and paved schoolyards

Table 2 gives an overview of the mean scores of parents from schools with green and paved schoolyards on questions about appreciation of the schoolyard, the behavior supported by the schoolyard, and issues with safety and dirt.

Table 2. Means (plus-minus standard deviation) at schools with green and paved schoolyards, with test values and effect sizes.

	Study	<i>N</i>	Total	Green	Paved	<i>F</i>	<i>p</i>	η_p^2
Appreciation								
<u>Satisfaction (1-5)</u>	1	136	3.41± 1.11	4.16±0.75	2.78±0.97	83.34	<.001	.38
<u>Grade schoolyard (1-10)</u>	2	264	6.47±1.45	7.05±1.29	5.82±1.35	57.02	<.001	.18
<u>Evaluation (1-5)</u>	2	241						
Factor 1 'atmosphere'			3.30 ±0.89	3.78 ±0.66	2.69 ±0.77	139.1	<.001	.37
Factor 2 'clean and safe'			3.60 ±0.90	3.47 ±0.95	3.76 ±0.82	36.12	.014	.03
Behavior								
<u>Behavior in schoolyard (1-4)</u>	1	135						
Play together			3.90±0.33	3.89±0.36	3.90±0.30	<1	ns	.00
Conflicts			2.49±0.69	2.40±0.64	2.58±0.73	2.30	.131	.02
Activity girls			3.48±0.64	3.61±0.62	3.38±0.65	3.83	.05	.03
Activity boys			3.60±0.60	3.68±0.57	3.54±0.63	1.97	.163	.02
<u>Support of behaviors (1-4)</u>	2							
Social behavior		218	3.22±0.49	3.22±0.49	3.22±0.50	<1	ns	.00
Active and varied play		241	3.12±0.57	3.29±0.55	2.90±0.52	32.36	<.001	.12
Environmental behavior		219	2.41±0.78	2.77±0.77	1.97±0.62	74.08	<.001	.26
Safety and dirt								
<u>Safety problems (1-5)</u>	1							
Accidents		136	2.52±0.71	2.58±0.69	2.47±0.73	<1	ns	.00
Lack of overview		127	2.46±0.83	2.60±0.86	2.33±0.80	3.37	.069	.03
<u>Dirt</u>	1/2							
Coming home dirty (1-5)	1	137	2.69±0.99	3.33±0.86	2.14±0.73	77.92	<.001	.37
Coming home dirty (1-7)	2	257	3.43±1.92	3.91±1.87	2.87±1.93	20.48	<.001	.07

Appreciation of the schoolyard

As shown in Table 2 parents from schools with a green schoolyard show more appreciation of their schoolyard than parents from schools with a paved schoolyard. Parents of

green schoolyards on average are well-satisfied with their schoolyard, give it a more than sufficient grade, and consider their schoolyard to have a positive atmosphere. Whereas parents of paved schoolyards are more neutral in their evaluations. However, although parents generally consider their schoolyard to be clean and safe, parents from schools with a green schoolyard rate the schoolyard as less clean and safe than parents from schools with a paved schoolyard.

Children's Behavior

As shown in Table 2, most parents in Study 1 indicate that children often play together, and that conflicts do not occur very often, regardless of whether the schoolyard is green or paved. While physical activity levels of girls in the schoolyard are generally rated to be lower than those of boys, parents from schools with a green schoolyard report higher physical activity levels of girls than parents from schools with a paved schoolyard.

According to parents in Study 2, green and paved schoolyards are equally supportive of social behavior. Across both types of schoolyards more than 90% of parents find it true or completely true that the schoolyard supports children to play together and act responsibly towards each other. However, parents from schools with green and paved schoolyards differ in the degree to which they rate the schoolyard supportive of active and varied play. A large majority (92.7%) of parents from schools with a green schoolyard find it true or completely true that the schoolyard supports physical activity and varied play, against 76.6% of parents from schools with a paved schoolyard. These differences are even more pronounced for environmental behavior. On average, 63.6% of parents from schools with a green schoolyard find it true or completely true that the schoolyard supports children to learn about nature and to act responsibly to the environment, against only 24.7% of parents from schools with a paved schoolyard. However, parents in Study 2 rated environmental behavior as important (58.4%) less often compared to social behavior (92.6%) and active and varied play (95.4%).

Safety and dirt

In general not many problems with safety are reported. Most parents in Study 1, regardless of whether their schoolyard is green or paved, indicate that accidents and problems arising from children being outside of the view of the supervising teacher occur almost never or sometimes.

Across both studies, parents from schools with a green schoolyard report their child coming home dirty more frequently than parents from schools with a paved schoolyard. However, when asked whether they mind when their child comes home dirty, the majority of parents in both studies (> 78%) say they do not mind. In Study 1, where parents could only choose between 'yes' or 'no', there was no significant difference between parents from schools with green and paved schoolyards. In Study 2, where parents had the additional option of indicating that they mind 'a little', parents from schools with a green schoolyard significantly more often chose this option (27.7%) compared to parents from schools with a paved schoolyard (14.2%), $\text{Chi}^2(1) = 7.50, p < .01$.

Advantages and disadvantages of green schoolyards

In Study 1, parents were asked to list advantages and disadvantages of a green schoolyard by means of open-ended questions. Table 3 gives an overview of the themes that were identified and the prevalence of the themes amongst parents from schools with a green and parents from schools with a paved schoolyard.

Table 3. Percentages of advantages and disadvantages of a green schoolyard mentioned by parents from schools with green and paved schoolyards, with test values (Study 1).

	Total (N =137)	Green (N = 63)	Paved (N = 74)	Chi²	p
Advantages					
Environment					
Aesthetics, nice atmosphere	30.7%	19.0%	40.5%	7.40	< .01
Nice play environment	16.8%	23.8%	10.8%	4.12	< .01
Activity					
Challenge, discovery, adventure	22.6%	23.8%	21.6%	<1	ns
Varied play	16.8%	14.3%	18.9%	<1	ns
Physical activity	8.8%	12.7%	5.4%	2.27	.13
Shelter, play hide- and- seek	3.6%	3.2%	4.1%	<1	ns
Nature					
Experience, connect, respect nature	21.2%	22.2%	20.3%	<1	ns
Learn about nature, outdoor education	15.3%	22.2%	9.5%	4.27	<.05
Health and well-being					
Healthy, restorative	26.3%	14.3%	36.5%	8.66	<.01
Safe, less incidents	10.2%	15.9%	5.4%	4.06	<.05
Protection from sun	7.3%	1.6%	12.2%	5.62	<.05
Other					
	6.6%	7.9%	5.4%	<1	.00
Disadvantages					
Maintenance and costs					
	25.5%	27.5%	32.4%	4.01	<.05
Dirt					
Dirt in general	12.4%	13.1%	14.5%	<1	ns
Dirty clothes	9.5%	14.3%	5.4%	3.13	.08
Safety and health					
Lack of overview	11.7%	12.7%	10.8%	<1	ns
Dangers and accidents	9.5%	7.9%	10.8%	<1	ns
Insects, pests, allergies	5.8%	7.9%	4.1%	<1	ns
Restricted play opportunities					
	10.2%	12.7%	8.1%	<1	ns

Advantages

A total number of 270 advantages were mentioned by parents in Study 1, with an average of 1.97 per parent (range 1-6). Twelve out of 137 parents mentioned no advantages. One parent (from a school with a green schoolyard) explicitly said that she did not see any advantages of a green schoolyard. The average number of advantages mentioned did not differ between schools with a green and a paved schoolyard, $p > .4$. However, responses by parents from schools with a green schoolyard were generally more detailed and elaborate. For example, while a parent from a school with a green schoolyard would say ‘gardens, animals, grass etc. constitute a healthy living environment that can indirectly be very educational for children’, a parent from a school with a paved schoolyard would simply say ‘it is healthy and children can learn about nature’.

Advantages of green schoolyards were categorized into four broad themes. The first theme relates to positive aspects of the schoolyard environment. Within this theme, two subthemes were distinguished: aesthetics (e.g., a nice look and atmosphere), and a nice play environment for children (e.g., more pleasant for children to play). Although both advantages were broadly recognized, there were significant differences between parents from schools with green and paved schoolyards. First, while being the most frequently mentioned advantage by parents from schools with a paved schoolyard, aesthetics were less often mentioned by parents from schools with a green schoolyard. Instead, parents from schools with a green schoolyard most often mentioned as an advantage that the schoolyard is a nice play environment for children. This suggests that parents who have experience with a green schoolyard take more notice of how children experience and evaluate the schoolyard than parents who do not have such direct experience.

The second theme relates to children’s activities afforded by the schoolyard. Within this theme, four subthemes were distinguished. First, the most frequently mentioned advantage

within this theme is that a green schoolyard is challenging for children and promotes discovery, adventure and fantasy play. It is also frequently mentioned that a green schoolyard promotes varied play. Some parents also mentioned that a green schoolyard can promote physical activity, and provides places for hiding and shelter, that can be used, for example, to play hide- and- seek. There were no significant differences between parents from schools with green and paved schoolyards in the frequency with which these activity-related advantages are mentioned, although the promotion of physical activity was somewhat more often mentioned by parents from schools with a green schoolyard.

The third theme relates to the naturalness of a green schoolyard. Within this theme, the most frequently mentioned advantage by parents, regardless of whether their own schoolyard is green or paved, is that children can experience nature, connect to nature, respect nature, and enjoy being outdoors. Parents from schools with a green schoolyard also frequently mention that a green schoolyard enables children to learn about nature, and that it provides opportunities for outdoor education.

The fourth theme relates to health and well-being benefits. Within this theme, healthy and restorative effects (e.g., nature is calming, brings peace of mind, improves mood) are most frequently mentioned. Parents also mention that a green schoolyard is safe (mostly because the ground cover is soft, so that accidents from falling are less severe), and that it offers shadow and thereby protection from the sun. Parents from schools with a green schoolyard more often mention that it is safer for children, while parents from schools with a paved schoolyard more often mention benefits related to health and protection from the sun.

Parents also mentioned advantages that could not be classified into the four main themes. These other advantages included the naturalness of the schoolyard itself and the fact that it promotes biodiversity, that a green schoolyard stimulates all senses, that it provides opportunities for self-development, and that children feel at home in the schoolyard.

Disadvantages

A total number of 123 disadvantages were mentioned by parents in Study 1, with an average of 0.9 per parent (range 1-4). Thus, parents mentioned less than half as many disadvantages as advantages. Forty-eight out of 137 parents mentioned no disadvantages, of these, 21 explicitly said that they did not see any disadvantages. The number of disadvantages mentioned did not differ between parents from schools with green and paved schoolyards, $p > .37$. With a few exceptions, answers were generally short and not very detailed.

Disadvantages of green schoolyards were categorized into four broad themes. The first theme relates to maintenance and costs. Although it is broadly recognized that a green schoolyard requires more maintenance and is more expensive, this disadvantage is most frequently mentioned by parents from schools with a paved schoolyard.

The second theme relates to dirty clothes and dirt in general (e.g., children bringing sand into the classroom). Within this theme, children coming home with dirty clothes is somewhat more often mentioned by parents from schools with a green schoolyard. However, several parents (4.4%) explicitly added that they do not consider this to be an actual problem.

The third theme relates to safety and health issues. The most frequently mentioned disadvantage within this theme is a lack of overview, which makes it more difficult for teachers to keep an eye on the children, and gives children more hiding places where they can hurt other children. The second most frequently mentioned disadvantage in this theme is that green schoolyards can be dangerous and pose a higher risk of accidents, such as falling from a tree or drowning in a pond. Parents also mention health risks, such as nuisance caused by insects and pests, and allergies. The disadvantages within this category are generally mentioned by only few parents ($< 13\%$) and there are no differences between parents from green and paved schoolyards.

The fourth theme relates to restricted play opportunities for children. This is a broad theme that includes several issues. Parents, for example, remark that the space that is taken up by trees and bushes cannot be used for playing, and some also say that a green schoolyard offers less opportunities for playing games like soccer. Parents also note that the playground can become muddy and less playable when it rains, and that grassy fields can become trampled, after which they need to be fenced off for a long time in order to recover. Some parents also mention problems with vandalism and litter. There are no differences between parents from schools with green and paved schoolyards in the frequency with which these disadvantages are mentioned.

All disadvantages could be classified under the four main themes, parents did not mention any other disadvantages.

Parental involvement

Parents in Study 2 from schools with a green schoolyard answered several questions about their involvement and willingness to help. When asked how they were involved in designing the green schoolyard, 9.1% selected the option 'No involvement', 8.7% selected the option 'Only through the parent advisory council', 6.8% selected 'Only through a select group', and 5.3% selected 'All parents a direct voice'. Notably, parents from the same school often selected different types of involvement, indicating that it was not very clear to parents how involvement was arranged. This is further illustrated by the fact that 17.4% of the parents selected the option 'other, namely...' and many who selected this option said they do not know how involvement was arranged.

When asked how they would prefer to be involved, most parents indicated that they prefer involvement through a representative group, for instance via the parent advisory council (39.0%) or a select group (27.6%). 'All parents a direct voice' was also chosen regularly

(21.1%). Suggestions given at the answer option 'Other namely' were: putting the children and their wishes first, enabling all parents to send in ideas but having a select group take the decision, having no parental involvement or taking a democratic vote to several options (12.3% in total, each option individually < 5%).

When asked whether they would be willing to help with maintenance of the green schoolyard, over half of the 129 parents (51.7%) who answered this question said that they are not willing to help, 24.1% were willing to help regularly (every three months or more often), and 20.7% were willing to help every now and then (every half year or every year). Parents showed more willingness to help with activities such as organizing festivities or lessons in the green schoolyard. Only 25.4% of the 134 parents who answered this question were not willing to help with activities, 42.5% were willing to help regularly, and 22.5% were willing to help every now and then.

When asked whether something hindered them in helping with the green schoolyard, most of the 112 parents who answered this question reported they do not have enough time to help (36.6%). Approximately 1 in 5 parents (22.3%) did not report any obstacles. Other parents said they feel school is already too demanding in requesting help (16.9%), that they did not know there was a need for help (6.2%) or lack the expertise needed (5.3%). Reactions given at the answer option 'Other namely' were: a school shouldn't ask parents for this, I don't feel like it, personal circumstances, children and teachers should be involved first, major maintenance is needed before leaving it up to volunteers, or that they are unhappy with the green schoolyard altogether (all < 5%).

Discussion

In the present study data from two studies in the Netherlands were used to gain more insight in parental perspectives on green schoolyards. Parents from schools with a green schoolyard generally showed higher appreciation of their schoolyard than parents from schools with a paved yard, as indicated by their higher levels of satisfaction and more positive evaluations of the atmosphere at the schoolyard. However, green schoolyards were rated as less 'clean and safe' than paved schoolyards, and parents reported higher frequencies of children coming home dirty. Most parents said they do not really mind when this happens, although parents from schools with a green schoolyard more often minded a little than parents from schools with a paved schoolyard. These findings are in line with previous evaluations of green schoolyards (Van Nispen tot Pannerden et al., 2014) which also indicate that parents usually do not mind dirty clothes, if a school invests in involving parents and creating support for the green schoolyard. In general, the findings of the present study suggest that parents do appreciate the green schoolyard and recognize its positive qualities.

Most parents find it important that children can engage varied and active play in the schoolyard, and they generally consider their schoolyard supportive of these behaviors. Parents from schools with a green schoolyard, however, more often report that their schoolyard supports varied play behavior and physically active play than parents from schools with a paved schoolyard. This is consistent with previous research showing that green schoolyards can stimulate more varied and active play behavior (see for a review, Chawla, 2015). When asked separately for boys and girls, parents only report girls to be more physically active in green schoolyards. This finding is consistent with previous research (Coen et al., 2019; Pagels et al., 2014) , and can be related to the fact that paved schoolyards are often dominated by boys playing soccer and other high speed activities, while green schoolyards offer more diverse

opportunities for active play that also appeal to girls (Mårtensson et al., 2014; Mitchell, Tillmann, & Gilliland, 2018).

Parents also find it important that children engage in social behavior in the schoolyard. Both parents from schools with a paved schoolyard and parents from schools with a green schoolyard generally consider their schoolyards to be supportive of social behavior. This finding goes against general notions that contact with nature can foster social cohesion and affiliation with friends (Hartig, Mitchell, de Vries, & Frumkin, 2014). However, school children tend to spend much of their time playing together, and conflicts do not happen very often and may not be very noticeable to parents. This suggests the importance of informing parents on the possible benefits of schoolyard greening for children's social well-being.

An advantage of green schoolyards that is generally recognized by parents is that these provide more opportunities for learning about nature and how to act responsibly to the environment. This finding is in line with pedagogical views on the value of natural playgrounds for outdoor education (Bentsen et al., 2009). However, since many parents also indicate that they do not find it very important that a schoolyard supports environmental behavior, this advantage should not be overestimated.

In general, parents see more advantages than disadvantages of a green schoolyard. Moreover, many parents emphasize that disadvantages, such as children coming home dirty more often, are not very important to them. Parents from schools with green and paved schoolyards broadly recognize the same advantages and disadvantages. However, parents who have experience with a green schoolyard are more detailed and elaborate in their answers, more often frame the advantages from a child perspective, and they are less concerned about disadvantages related to maintenance and costs. This inside information could be shared with parents from schools with paved schoolyards to give them a more positive and realistic image.

Parents from schools with a green schoolyard indicate they want to be involved, in designing the schoolyard by a representative group, and individually in helping with activities and to a lesser extent with maintenance. This basically positive attitude provides a starting point for more action-oriented, participatory approaches to creating involvement, such as the formation of inclusive learning communities that link parents, teachers, and children in partnership (Davis & Cooke, 1998). These approaches may help partners to discover forms of collaboration that appeal to shared interests, needs and abilities, instead of schools just hierarchically asking parents to do what they want. For example, by assisting teachers with outdoor learning in the green schoolyard, parents may become more engaged with both the green schoolyard and children's learning (Goodall & Montgomery, 2014; Van Dijk-Wesselius, van den Berg, Maas, & Hovinga, 2019).

Strengths, limitations and implications for future research

This study provides some first insights in parental views on green schoolyards. Because there was a group of parents with children in schools with a green schoolyard and a group with children in schools with a paved schoolyard, comparisons could be made instead of showing one side of the story. The combination of closed and open-ended questions gives a wide array of information. At the same time the use of pre-structured questionnaires poses a limitation, often only one sentence or one word, limiting in-depth insight in their views. Many respondents gave very short answers to the open-ended questions. Future research could use face-to-face interviews with parents to gain more extensive insight.

Another limitation is that this study may not be fully representative due to overrepresentation of highly-educated women and the low response rate in Study 2. Future research could use techniques that ensure a higher and more gender-balanced response, for example, a survey that is given to the parents directly during parent night. Another concern with

representativeness is that this study was done in the Netherlands, with cultural values possibly affecting the results. As the green schoolyard movement is gaining momentum in other countries too (Hoffman, 2010), future research could look at parental opinions in an international setting.

Because the study used a cross-sectional design, causal inferences about the impacts of a green schoolyard cannot be made. It is possible that differences in parental views between green and paved schoolyards are caused by variables other than naturalness. For example, green schoolyards were bigger than paved schoolyards, which may partly explain the differences. By using longitudinal or experimental designs future research may provide more insight into the causal role of naturalness in parental views of schoolyards.

A last limitation is that this study used questions on how parents think their children experience the schoolyard. However, answers to these questions may have limited validity since parents spend little time at or near the schoolyard while children are playing there. When answering the questions, parents probably relied mostly on their children's (and their teachers') stories. So some caution is warranted in drawing inferences from the current findings on the impact of green schoolyards on children's play behavior and well-being. Future research could place parental views next to the views of teachers and children to gain a more complete image of users' views of a green schoolyard. Comparison with objective measurements (e.g., accelerometer assessments or systematic observations of play behavior) can provide insight into how accurate parental views are when it comes to green versus paved schoolyards.

Concluding comment

In conclusion, this study shows that parents recognize many advantages of green schoolyards but they see downsides too. Thus, for schools it is important to communicate about the up- and downsides of a green schoolyard, why choices are made and how obstacles can be

overcome. Parents want to be involved in the green schoolyard, but only up to a certain extent. Thus, schools should embrace the positive perception of parents and be sensitive for their needs, concerns and capabilities. A good starting point for collaboration can be parents' willingness to help with activities. In general the results indicate a potential for parental involvement in green schoolyards, which, if used in a careful and constructive way, may contribute to the development of a blossoming green schoolyard where children can prosper and grow.

Acknowledgment

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5

Chapter 5

Green Schoolyards as Outdoor Learning Environments: Barriers and Solutions as Experienced by Primary School Teachers

This chapter is based on Van Dijk-Wesselius, J.E., van den Berg, A.E., Maas, J. & Hovinga, D. (2020).

Green schoolyards as outdoor learning environments: Barriers and solutions as experienced by primary school teachers *Frontiers in Psychology*, 10:2919.

Abstract

With a growing number of primary schools around the globe greening their schoolyards, opportunities arise to realize outdoor learning in natural areas on the schools' premises. Despite their promising potential, green schoolyards as outdoor learning environments remain mostly unintegrated in teachers' educational practices. In the current study, teachers of five primary schools in The Netherlands were followed for two consecutive years during a participatory action research project. Based on their experiences in this project, teachers identified barriers when integrating the green schoolyard as a learning environment and found practice-based solutions to overcome these barriers. Across schools, a total of 20 meetings were organized and 75 teachers participated in the project. Results revealed four broad themes encompassing barriers and solutions. Teachers feel hindered by outdoor learning having no formal status in their current educational practice, experience barriers related to a lack of confidence in their own outdoor teaching expertise, find it difficult to get started, and experience barriers related to physical constraints. Teachers, professionals and researchers together found solutions to overcome each specific barrier. These solutions can be translated to general recommendations: just do it, get educated and inspired, engage in real-life experiences, get an outdoor pedagogical mindset and follow a tailored process. The findings can be used by primary schools and other institutions to develop interventions that support teachers to further integrate the green schoolyard as a learning environment.

Keywords: Collaborative action research, experiential learning, outdoor learning, reflective experiences, schoolyard greening, teacher training,

Outdoor learning in natural areas can be an enrichment for children to learn beyond the borders of their classroom, and has the potential to directly and indirectly strengthen primary schools' educational practice (Blair, 2009; Rickinson et al., 2004; Wistoft, 2013). (Goodall, 2016) Most literature regarding outdoor learning is concerned with activities in natural areas outside the school's premises such as field trips, outdoor adventure activities, forest schools, school gardens and nature education programs. Despite the promising potential of such extracurricular outdoor learning activities, teachers often feel hindered to facilitate and improve children's access to these types of outdoor learning by factors related to transportation, curriculum requirements, shortages of time and resources (Edwards-Jones, Waite, & Passy, 2018; Rickinson et al., 2004). With a growing number of primary schools re-designing their schoolyards into green schoolyards with natural features such as grass, hills, trees, flowers, bushes, sand and water, opportunities arise to realize more easy to accomplish outdoor learning activities in natural areas on the school's own premises (Danks, 2010; Van Dijk-Wesselius et al., 2018). However, green schoolyards as learning environments remain mostly unintegrated in teachers' educational practices. Amongst others, this may be due to teachers' unfamiliarity with outdoor learning and lack of hands-on experiences (Dyment, 2005; Maynard & Waters, 2007). As part of a two-year collaborative action research project, the current project examined the barriers teachers experience when they actually attempt to realize outdoor learning in the schoolyard, and what solutions they find to be supportive in overcoming these barriers.

The green schoolyard as an outdoor learning environment

Green schoolyards and other natural areas such as forests, parks, woodlands and gardens afford a meaningful context for childhood education, as they provide children with numerous opportunities for informal and formal learning experiences (Auer, 2008; Ballantyne & Packer, 2009; Dyment, 2005; Sahrakhiz, Haring, & Witte, 2018). While playing in a green schoolyard,

children are invited to handle, touch, smell, explore and modify natural features with their entire body. These informal, child-initiated, embodied learning experiences can make important contributions to children's emotional, cognitive, social and physical development (Chawla & Nasar, 2015; Dymont & Bell, 2007b; Kelz, Evans, & Röderer, 2013; Van Dijk-Wesselius et al., 2018).

Green schoolyards can also be used as an 'outdoor classroom' for teaching regular classes in subjects such as reading, writing, mathematics, sciences, art, drama and environmental education (Dymont, 2005; Rickinson et al., 2004). In this more formal approach to outdoor learning, learning comes alive through a kinesthetic, sensory and experiential learning style (Lieberman & Hoody, 1998). Teachers become facilitators of learning and guide children through open and flexible real-life, bodily experiences that connect to a child's abilities, needs and interests (Harris, 2017). In outdoor learning, these hands-on experiences become the foundation for minds-on learning that extends beyond the formal curriculum (Johnson, 2007; Lieberman & Hoody, 1998).

A recurrent finding of research on the benefits of formal types of outdoor learning is that it enlivened enthusiasm, increased vitality and motivation for learning (Rickinson et al., 2004; Waite, Bølling, & Bentsen, 2016; Wistoft, 2013). In addition, outdoor learning can reduce behavioral and concentration problems, in particular among children with difficult or mixed temperaments and children that are uninspired in the traditional classroom (Blair, 2009; Dymont, 2005; Fiskum & Jacobsen, 2012; Kuo, Browning, & Penner, 2018; Largo-Wight et al., 2018). Other demonstrated advantages of outdoor learning include improved academic achievement, observational capability and reasoning skills (Becker, Lauterbach, Spengler, Dettweiler, & Mess, 2017; Bell & Dymont, 2008; Blair, 2009; Browning & Rigolon, 2019; Lieberman & Hoody, 1998; Ozer, 2007), enhanced self-esteem, independence and feelings of responsibility (Ozer, 2007; Rickinson et al., 2004), improved interpersonal skills, cooperation

and social cohesion (Hartmeyer & Mygind, 2016; Ozer, 2007; Waite et al., 2016), and multi-disciplinary learning across subjects (Harris, 2015).

Barriers to realizing outdoor learning in the green schoolyard

Despite the potential of green schoolyards as outdoor learning environments, outdoor learning tends to remain largely unrealized in educational practices (Dyment, 2005; Feille & Nettles, 2017; Maynard & Waters, 2007; Skamp & Bergmann, 2001). Surveys among staff and parents of primary schools in Canada (Dyment, 2005) and the US (Feille & Nettles, 2017) show that only a small percentage of the teachers use green schoolyards as a learning environment. It is mostly used for physical education and science, most other subjects are rarely or never considered for teaching in the green schoolyard. Teachers express to feel hindered by a low confidence in their outdoor teaching expertise due to a lack of experience and knowledge. They report that curriculum requirements do not endorse or support outdoor learning and require the majority of teaching activities to be placed indoors. In addition, teachers indicate that broader issues within the education practice and beyond, such as work pressure, overload in responsibilities and a tiredness of educational changes hinders them to realize outdoor learning in the green schoolyard.

More information on the barriers teachers experience when actually attempting to engage in outdoor education is provided by interviews amongst teachers from a primary school regarding their use of so called ‘learnsapes’, a concept related to green schoolyards that includes natural and built features designed to be used for outdoor learning activities (Skamp & Bergmann, 2001). Teachers, for instance, found management of children difficult, were uncertain on how to use and incorporate learnsapes, found planning of outdoor learning more complex and struggled with outdoor learning not being a ‘real’ thing. Furthermore, some

teachers were timid about leaving the security of their classroom and the authors suggest that leaving the classroom requires a different ‘mindset’.

Several studies further reflect on outdoor teaching requiring a different mindset, and find that teachers feel hindered by an instrumental, indoor view on learning and teaching (Dyment & Reid, 2005; Maynard & Waters, 2007; Passy, 2014; Waite, 2011). According to these authors, outdoor learning is considered to be more free and unstructured compared to indoor classroom learning, and is characterized by experiential and child-directed learning. Teachers can feel bound by an instrumental view on teaching in which they wish to stay in control and, for instance, stick to predominantly teacher-directed lessons and wish to be able to see all children at all times. It can be difficult for teachers to overcome this conflict within the realities of their ruling educational system. In this light, several studies stress the importance of a fundamental shift to recognize outdoor learning as a legitimate form of learning and an important part of core competencies of teachers (Davies & Hamilton, 2018; Dyment, 2005).

Altogether, findings from previous studies suggest that most teachers are familiar with an indoor pedagogical approach, and realizing outdoor learning in the green schoolyard requires them to discover the pedagogical opportunities of a new learning environment and overcome barriers related to their own didactical competence and demands of the curriculum. However, it remains unknown how teachers can overcome these barriers in their everyday educational practice.

The current research

The current research was part of a larger collaborative action research project at five primary schools in the Netherlands. The project, called ‘becoming an outdoor teacher’, aimed to familiarize primary school teachers with using the green schoolyard as a learning environment and strengthen their didactical competence to realize and integrate outdoor

learning in the curriculum. During the project, teachers gained hands-on experience of the barriers they face when they try to integrate the green schoolyard as a learning environment in their educational practice, and were stimulated to seek solutions to overcome these barriers and realize opportunities for outdoor learning at the green schoolyard. The current research aimed to gain more insight in these barriers and solutions, as experienced by teachers while experimenting with outdoor learning in the green schoolyard.

Method

Context: Collaborative Action Research

The findings presented in this paper were collected in the context of a collaborative action research project. By maintaining the gestalt, the background and context of teachers' daily practice, this type of projects provide useful knowledge that has practical use (Khanlou & Peter, 2005). Collaborative action research is based on the assumption that new skills and knowledge in practices can be acquired when teachers systematically explore their own practice. In the collaborative approach used in the present study, researchers and professionals support teachers in their systematic reflections and explorations. Through these collaborations a community of practice emerges in which practice-based and practice-informed knowledge is developed together by teachers, professionals and researchers. In this approach, the finding of solutions to overcome barriers is placed within the context of teachers' hands-on experiences. This leads to the identification of solutions that are of direct relevance for teachers' practices and can as well be accumulated and transferred to other teachers, practices and the development of theories (Ponte, 2005; Ponte, Ax, Beijaard, & Wubbels, 2004).

The collaborative action research was operationalized through so-called 'green schoolyard meetings'. During two consecutive years at each participating school there were

several of these meetings. The cyclic process of collaborative action research is resembled in a spiral of steps in each meeting. The meetings started with an evaluation phase. In this part teachers reflected on the barriers and solutions they encounter in their experiences with outdoor teaching using an evaluation form and group discussion. This was followed by a phase that we labeled ‘inspiration moment’, consisting of exercises and other activities aimed to educate teachers. These inspiration moments were tailored to teachers’ specific needs. Finally, the last part of each meeting was the planning phase, in which teachers evaluated the inspiration moments and formulated a plan of action using an action planning form and group discussion. In the following meeting, the teachers reflected on the barriers and solutions they experienced while attempting to realize their planned actions, followed by an inspiration moment and finally developing a new action plan. This ongoing cycle of evaluation, inspiration and action is illustrated in the left part of Figure 1.

Throughout the project each individual teacher is in the lead of its own goals, action planning, realization and evaluation. Teachers directly benefit from their involvement in the project by professionalizing themselves as outdoor teachers. The role of the researchers was to facilitate the green schoolyard meetings and to support teachers in systematically evaluating barriers and solutions to realize their goals. The professionals had experience with outdoor learning in educational settings. Their role was to design and facilitate inspiration moments in collaboration with the researchers.

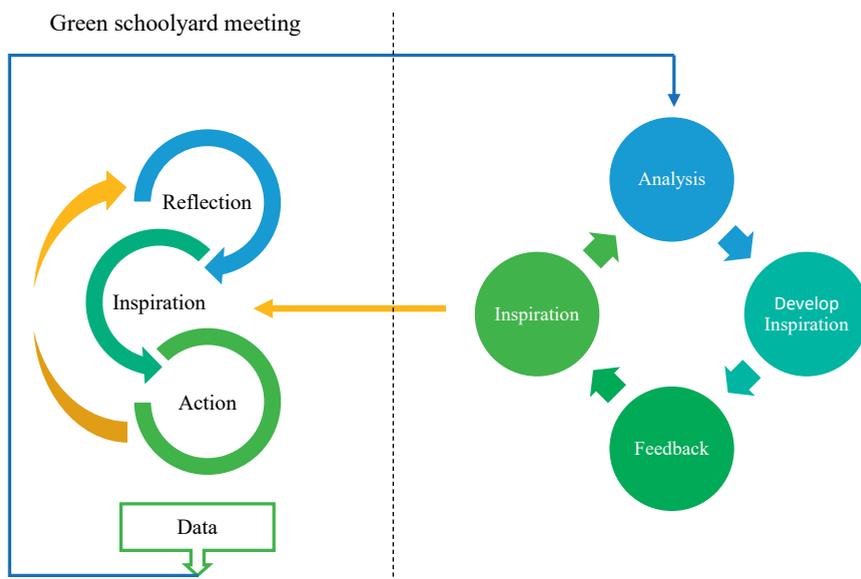


Figure 1 Collaborative action research design

Schools and schoolyards

Six primary schools in western parts of The Netherlands participated in the project. A main selection criterion for inclusion of schools was that they should all have a green schoolyard upon entering the project and are located in urbanized areas with limited green play opportunities for children. Another criterion was that the green schoolyard should not yet be an evident part of teachers' educational practice at the start of the project. School boards of schools that were potentially eligible for inclusion were approached directly by the research team. In a meeting with each potential school we discussed the onset of the project, required investment in time and commitment of the school to start using the green schoolyard as a learning environment. Ultimately six primary schools entered the project in two cohorts. Schools that declined to participate, mainly declined for a lack of time.

Three schools started in the first cohort that ran from September 2014 till July 2016, and three schools started in the second cohort that ran from September 2015 till July 2017 (see Table

1). In the first cohort one school quit the project after one month, for private reasons unrelated to the project. This school is not included in the present analysis, resulting in a final sample of five schools. Data from the remaining two schools in the first year of the first cohort were excluded from the present analyses, as they served to pilot test the materials. The two schools that remained in the first cohort, included a school in an extremely urbanized area (>2500 addresses per square kilometer) and a school in a strongly urbanized area (1500 to 2500 addresses per square kilometer). Both schoolyards were greened for several years. The second cohort also included a school in an extremely urbanized area, as well as a school in a moderately urbanized area (1000 to 1500 addresses per square kilometer). In addition, the second cohort included a school for children with special education needs in a moderately urbanized area. The school in the extremely urbanized area already had a green schoolyard for several years. The schoolyard in the moderately urbanized area had been greened for one year when the school entered the project. The school for children with special needs had a green area in the schoolyard that was destined to be further designed as a green schoolyard during the project. All schoolyards of the participating schools still had some paved parts with play equipment made of non-natural materials and green areas. The green areas in the schoolyards covered mostly features as grassy hills, bushes, trees, tunnels made of tree branches, loose tree branches, water parts, garden-like parts and vegetable gardens. Figure 2 gives an impression of the green schoolyards.



School 1



School 2



School 3



School 4



School 5

Figure 2 Impressions of the green schoolyard of each participating school.

Meetings and participants

At least six meetings were organized at each school across two consecutive years. Each meeting lasted for one and a half hour and was always held in the afternoon, after children were out of school. Due to issues non-related to the project school 3 in cohort 2 had to quit the project in February 2017, so at this school only three meetings were organized. Across the five schools, a total of 75 teachers (93.3% female) participated in a total of 20 meetings. The number of participants per meeting varied per school and per meeting, with a minimum of 5 in school 2 and a maximum of 13 in school 5 (see Table 1). More than two-third (69.7%) of the teachers participated in at least two meetings. At each school, teachers representing all grades, from

children in the age of 4 till 11, participated. Answers of teachers were anonymized to ensure their privacy.

Materials

During each meeting, teachers filled in two types of forms that asked them to reflect on their experiences with outdoor teaching (evaluation form) and the things that inspired them during the meeting (action planning form). Altogether, teachers filled in 182 evaluation forms and 182 action planning forms.

Evaluation form

During the evaluation phase, to get insight in the barriers and solutions teachers' experienced in their actions, teachers answered four open-ended questions on the evaluation form: (1) What defines your current experience with outdoor teaching? (2) What did you enjoy? (3) What barrier(s) did you experience? (4) What supported you to overcome these barriers? These questions are based on previous studies using action research as a method to stimulate systematic reflection. This is a process that can support teachers to increase awareness of their own experiences and stimulate a deeper form of learning beyond first impressions (Ponte, 2005). At the end of each meeting, each reflection form was photographed, so every teacher was able to keep their own reflection form.

Action planning form

During the action planning phase teachers filled in three open ended questions on the action planning form: (1) What inspired you during this meeting? (2) What implication does this has for your own educational practice? (3) How are you going to realize this? The current paper only discusses answers to question 1.

Procedure

During the project for each school one researcher was responsible for all communication and organization of the meetings. All researchers were trained by the leading researchers prior to the start of the project to ensure an adequate understanding of the design of the project and the use of the evaluation and planning form. Regular meetings between researchers were organized to discuss their experiences to increase the reliability and validity of findings. For instance, prior to the first meeting at a school the researcher visited the school to get acquainted and discuss the planning of meetings. The outcomes of these pre-focus meetings were discussed with all the researchers to ensure similarity in the onset of the projects on each school and minimize differences in data collection. Furthermore, after each meeting at each school researchers discussed their experiences and the analysis of barriers and solutions to increase triangulation of data analysis and the design of inspiration moments. After selecting salient barriers, together with the professional the researcher designed an inspiration moment. The proposed inspiration moment was discussed with the principal of each school to assure that it focused on the most prominent barrier, and if needed the inspiration moment was further adapted to their needs. This process is illustrated in the left part of Figure 1.

The materials and procedure were pilot-tested with participants of the first cohort in the first year, and adapted to better match the projects intentions and reality of the primary schools' daily practice. An important change concerned the implementation of inspiration moments in response to the observed need for education, in relation to the observation that teachers found it difficult to engage in actions due to a lack of familiarity with outdoor learning and ideas on how to get started.

Data analysis

Data were analyzed using qualitative content analysis (Mayring, 2000). Answers on each open question in the evaluation form and the first question in the action planning form were coded, categorized and clustered into themes and subthemes, by the researchers responsible for a school and the primary investigator. Themes and subthemes encompassed barriers and supportive aspects that teachers experience when facilitating outdoor learning. Analysis started with open, explorative coding of the original data based on similarities and relationships in the data. Answers to each separate question were read and primary codes were addressed in a few words. These codes were then compared in search for umbrella categories and clusters. Using inductive and deductive cycles, data was systematically assigned to these emerging codes, categories and clusters. First, this procedure was followed for each question individually. Second, the categories and clusters were aggregated across questions. Subsequent data analysis by the primary investigator followed three phases, in which emerging themes and subthemes relating to barriers and solutions were increasingly aggregated from the individual team meetings to school- and supra-school level. After aggregating the inputs from individual researchers responsible for organizing meetings, the final analyses were completed by discussing the themes and subthemes with all researchers.

To increase consistency and saturation of the analyzed categories and clusters in themes and subthemes, a triangulation process was implemented in a few steps. First, separate for each school after each meeting the responsible researchers transferred the analysis back to the school to ensure validity of the findings. Second, after analyzing the data from each meeting, researchers discussed ongoing analysis to compare categories and clusters between schools. Third, after completing the data collection and the subsequent meta-analysis across schools, the analysis was transferred back to all researchers and discussed in relation to the accurateness of aggregated themes and subthemes.

Results

As illustrated in Table 2, barriers and solutions for using green schoolyards as outdoor learning environments can be summarized in four broad themes and subthemes. The most mentioned barriers relate to outdoor learning having no formal status in teachers' educational practice (46.3%), followed by a lack of teachers' confidence in their own outdoor teaching expertise (32.2%), physical constraints related to a lack of maintenance and weather conditions (13.0%), and finding it difficult to get started (8.5%). During the project, teachers, researchers and professionals together found solutions to overcome each of these barriers. However, they found it relatively easy to find solutions to overcome a lack of formalization (64.8%) and to make it easier to get started (18.6%), while they found it relatively difficult to find solutions for strengthening teachers' confidence (12.0%).

In the following sections the barriers and solutions for each of the four themes will be discussed in further detail. Teamwork is found to be supportive across themes, and several aspects of teamwork will be discussed in relation to specific barriers and solutions.

Theme 1: The lack of a formal status of outdoor learning in teachers' educational practice

Teachers find it difficult that outdoor learning is not formalized in the current curriculum of their schools' organization. This puts a challenge on teachers to formalize outdoor learning themselves, while often they have no clear idea on what outdoor learning is and feel hindered by the demands of their existing curriculum. Within this theme, we distinguished three subthemes: Unfamiliarity with the value and opportunities of outdoor learning in natural areas and lack of inspiration, lack of time, and lack of communal structure. For each barrier solutions were identified.

Table 2. Barriers and solutions experienced by teachers in number of times mentioned and percentages of total.

No formal status outdoor learning	Lack of confidence in outdoor teaching skills	Difficult to get started	Physical constraints
BARRIERS			
Unfamiliarity and lack of inspiration	Fear of losing control	Difficult to get started	Lack of design and maintenance
30 (16.9%)	31 (14.7%)	15 (8.5%)	13 (7.3%)
Lack of time	Managing children's behavior		Weather conditions
28 (15.8%)	26 (17.5%)		10 (5.6%)
Lack of communal structure			
24 (13.6%)			
Total	Total	Total	Total
82 (46.3%)	57 (32.2%)	15 (8.5%)	23 (12.9%)
SOLUTIONS			
Inspiration moments to familiarize with outdoor learning	Teaching attitude	Decisive mind	Prevent child erosion
88 (25.2%)	22 (6.3%)	26 (7.5%)	8 (2.3%)
Inspiration by observing how children react to outdoor learning	Organization and rules	Step by step	Sunny weather
34 (9.7%)	15 (4.3%)	17 (4.9%)	8 (2.3%)
Inspiration through teamwork	Familiarize with outdoor learning	Pioneers	
33 (9.5%)	5 (1.4%)	14 (4.0%)	
Conscious choice to devote time		Inspiration	
25 (7.2%)		8 (2.3%)	
Develop communal framework			
23 (6.6%)			
Teamwork			
14 (4.0%)			
Incorporate outdoor learning in the curriculum			
9 (2.6%)			
Total	Total	Total	Total
226 (64.8%)	42 (12.0%)	65 (18.7%)	16 (4.6%)

Barrier: Unfamiliarity and a lack of inspiration

Teachers express the wish to meaningfully integrate outdoor learning within their educational practice, but feel hindered by their own unfamiliarity with outdoor learning and feel that their current didactical skills are inadequate to realize this. A teacher for instance expressed as a barrier: *‘Both myself and the children are unfamiliar with the green schoolyard and outdoor learning. I need to learn so much myself before I can take the children outside. I have a fear of nature and no knowledge, so I am afraid that children will ask me questions that I cannot answer and I have no clue on what I am allowed and not allowed to do outside (2B1Z)’*. Even if teachers already have undertaken some activities, they can still find it difficult to understand what they didactically can do with outdoor learning and how to meaningfully integrate it in their educational practice. As a teacher further exemplifies: *I started with enthusiasm to integrate the green schoolyard. Now I find it difficult, because I do not know exactly what I didactically can do with it (3B2Z)’* and another *‘How can I integrate outdoors in my lessons? (3B2LA)’*.

In response to an unfamiliarity with outdoor learning, some teachers express their need for inspiration and ideas. A teacher for instance wrote down *‘I am a plant in need of nutrition (3B2Z)’*. Further, after having done a first activity, some teachers feel hindered to continue with formalizing outdoor learning by not having a new idea and find it difficult to keep generating new activities themselves. Teachers for instance literally wrote down as a barrier: *‘What’s next? (5B2LA)’* and another *‘To think up activities that are varied (5B5LA)’*. Related to this issue, some teachers express that it is difficult to *‘To stay motivated (3B1LA)’* and *‘To stay enthusiastic and motivated (3B2La)’*

Solutions to overcoming unfamiliarity and a lack of inspiration

Inspiration moments to familiarize with the value and opportunities of outdoor learning

Teachers state that it was supportive during green schoolyard meetings to be inspired by an experienced outdoor teacher and to experience outdoor learning activities themselves. After meetings teachers for instance wrote down as inspiring: *'The workshops outside (5B4I)'* and *'The green schoolyard meetings, that function as an example (2B6S)'*. Actively participating in outdoor learning activities, like for instance short activities related to mathematics or language skills, supported teachers to familiarize themselves with the concept of outdoor learning and lowered the threshold to actually start experimenting with outdoor learning in the green schoolyard themselves. A teacher for instance described after an inspiration moment: *'I felt my shoulders relaxing, I definitely want to start doing it myself (2B3Z)'* and another *'The tranquility I experienced by concentrated and with attention feeling the objects with my senses (3B2I)'*. Teachers valued the simplicity of outdoor learning activities, and the suggestion to start with small and easy to carry out activities. As teachers wrote down as inspiring: *'The simple things you can do outside (3B3I)'* and *'Small things you are doing can already be big. Unconsciously there are a lot of learning opportunities (1B4I)'*. Furthermore, teachers in particular valued activities that were accompanied by theoretical background on the value of outdoor learning. As teachers wrote down as inspiring: *'The activities with Marcel and the information on using your senses (4B5I)'* and *'The information on how a green learning environment inspires learning and fosters children's ability to concentrate (1B4I)'* and *'Do not let children learn one-dimensional from books, but go outside to experience, move around, to make learning meaningful (3B1L)'*. In addition, teachers felt inspired by opportunities to incorporate outdoor learning with existing subjects. A teacher for instance wrote down as inspiring: *'Develop your senses through small exercises in combination with vocabulary (1B1L)'*.

After the meetings, we observed teachers integrating the inspiration in their own daily practice. For instance, teachers organized outdoor learning activities that provide children with experiences to use all their bodily senses, and guide them to further develop their observational skills. As teachers for instance reported on activities: *'A lesson on observing: Look at that tree. It's color, it's shape. Look again: tell me what else you see (4B6Z)'* and *'Senses, tasting, feeling, we practiced observing (4B6S)'*. In addition, teachers connected exploring and observing natural features to subjects as mathematic and languages. Teachers for instance wrote down: *'Planting bulbs, measuring how deep. How does it feel? They emerge. Feel, smell, look at the earth, the clay and sand (3B2L)'* and *'Chestnuts, pine cones, shells as materials to practice mathematics (4B5Z)'*.

Inspiration through teamwork

Teachers describe how they can inspire each other to facilitate outdoor learning in their educational practice through collaborating, sharing ideas and experiences. Teachers, for instance, wrote down as supportive: *'Collaboration (4B7S)'* and *'Sharing ideas with a colleague (2B5S)'* and another teacher wrote down as inspirational: *'The stories and ideas from colleagues (4B4I)'*. Realizing outdoor learning together can be a positive contribution to the team in itself. A teacher for instance wrote down about her experiences: *'Joint responsibility for developing a focus for outdoor learning is an enrichment for the team (4B8Z)'*.

Inspiration by observing how children react to outdoor learning

In all schools we observed that real-life experiences in teachers' own daily practice are supportive to further familiarize with outdoor teaching. Teachers for instance described as supportive: *'Keep on experimenting (4B8S)'* and *'The day in which I tried out a few activities. Fun, surprising and informative results (5B4L)'*. Across all schools and meetings we observed

how teachers are inspired in these real-life experiences by children's reactions to outdoor learning. We observed an ongoing sense of joy and enthusiasm when teachers described their outdoor learning activities with children. For instance, the words '*Enthusiasm (4B1L)*' and that '*Children were having fun (5B4L)*' were mentioned frequently across all meetings by teachers when asked what they enjoy and what motivates them and teachers for instance wrote down as inspiring: '*The children! By their enthusiasm (3B3I)*'. In addition, teachers describe that they enjoy to observe children being wondered by natural elements and how it opens up opportunities for learning. A teacher for instance wrote down as motivating: '*When children discovered something and are surprised about it (3B3L)*' and '*Children's amazement about something (5B4L)*'. Other teachers, for instance, wrote down that they enjoyed: '*To observe how children were enjoying the mathematics assignment, without them really noticing that we were working on mathematics (4B8L)*' and '*Every child chooses for something else, I enjoy to see so many differences. It is really special to see that they choose something that really suits them (4B5L)*' and '*You are getting to know your children in a different way (5B3L)*'.

Furthermore, some teachers value that outdoor learning activities can foster group dynamics, by stimulating social cohesion and collaboration amongst children. Teachers for instance wrote down that they enjoyed: '*To observe children collaborating in the schoolyard (5B5L)*' and '*A solid foundation for social cohesion in the group. Eating outside together: tranquility and social cohesion (5B3I)*' and '*Collaboration and discover each other's strengths (and weaknesses) (4B4Z)*'. Teachers also observe how outdoor learning fosters environmental awareness, and enjoy to learn children take care of the environment, respect nature and overcome fears for nature. Teachers for instance wrote down that they enjoyed: '*Watering the plants (3B1L)*' and '*Children are getting more involved with nature. Searching for small insects, pretty flowers, and how do you take care of it (3B3L)*' and '*To observe a change within children. For instance a child that was scared at first for everything that was green and small*

(insects), and now behaves more comfortable and free and are more daring (4B8L)'. Lastly, teachers value the tranquility and space being outdoors literally can give, for instance to allow children to move around and relax: *'It meets children's need to move around (4B7Z)*' and *'Children can calm down (5B1L)*'.

These positive experiences with outdoor learning seem to enforce a motivation in teachers to further explore outdoor learning and their own capabilities as an outdoor teacher, and make time for outdoor learning. As they experience outdoor learning to be a valuable contribution, it becomes worthy to devote time to outdoor learning at the cost of something else. As a principal, for instance, said during a meeting: *'It is the art of letting go. If something like this [ed. outdoor learning] comes in its place. At a certain point you have to do it (2B3Z)*'. A teacher further explains: *'I experienced what it can bring, so it may cost time (2B4Z)*'. For this particular teacher, lack of time was a main reason not to teach outdoors. However, after she experienced an outdoor learning activity she was willing to invest time and even became a pioneer in her team.

Barrier: Lack of time

At the start of the first meeting, a few teachers simply wrote down the word *'Time'* as a barrier. We observed how this was nuanced across the meetings, as teachers describe how their daily practice follows a tight and set schedule, in which outdoor learning literally has no place yet. Teachers for instance wrote down as barriers: *'I have a lot of ideas, but no time to give it a place in my daily practice (5B6Z)*' and *'I am looking forward to start, but I haven't had the time to make a plan (5b2Z)*'. Even if teachers have an idea for an outdoor learning activity, their tight schedule makes it difficult to find a moment to go outside. Teachers for instance reported as barriers: *'To schedule in time (4B8L)*' and *'To place my outdoor activity in my daily practice (3B1LA)*'. The tight and set schedule of teachers is filled with a full educational program, with

responsibilities and tasks that hinder teachers to invest time in outdoor learning. A teacher for instance wrote down as a barrier: *'It is difficult to make time besides all the other obligations, like CITO, monitoring learning outcomes, children's behavior, meetings, etc..(4B8LA)'*. As another teacher frames it: *'There is so much to do and so little time (5B4LA)'*. A teacher further clarifies how in the ruling educational program finding time for outdoor learning is difficult, as it is becoming something additional, instead of an integrated and valued part of the curriculum. As she wrote down: *'It is difficult that there are only things being added to our work, but you also have to account for what you do. Barriers would be reduced if outdoor learning would be incorporated in our methods. Because: where do I find the time? Every additional thing that I do has to come from somewhere (2B2Z)'*. Furthermore, within their full and tight daily practice, outdoor learning gets easily lost in other priorities. As teachers illustrate *'Our daily practice is too hectic at the moment, to prioritize outdoor learning (5B6LA)'* and *'Due to other priorities, I had insufficient time to practice with outdoor learning (5B1Z)'*.

Solutions to overcoming a lack of time

Make a conscious decision to devote time to establish outdoor learning.

First, teachers mentioned it as supportive to consciously put outdoor learning activities on their schedule. Teachers for instance suggest to *'Schedule it in (2B4S)'* and *'Include it in the planning (5B6S)'* and *'Put what you intend to do on your schedule and execute' (4B8S)*. Second, teachers suggest to make time beforehand to prepare an outdoor learning activity. A teacher, for instance, wrote down: *'Preparation in terms of materials, etc.' (4B7S)* and another *'Preparations!!! (5B2S)'*. Lastly, some teachers express the importance of creating a routine, make it a habit to go outside. As teachers, for instance, wrote down: *'Repetition (5B3S)'* and *'Regularity (5B3S)'*. Furthermore, pioneers in a team can support a conscious decision to devote time to integrate the green schoolyard as a learning environment, by taking responsibility for

outdoor learning not getting lost in the hectic daily practice. In one school, for instance, a teacher wrote: *‘There are two or three pioneers who actively manage the garden and consistently put it on the agenda, which keeps it alive (also in the autumn and winter) (4B8S)’*. In addition, a few teachers suggest to give outdoor learning more priority by devoting time to the subject together as a team. A teacher for instance wrote down: *‘The green schoolyard meetings (5B4S)’* and another *‘Put it on the agenda during team meetings (2B6S)’*.

Incorporate outdoor learning in the curriculum

A few teachers suggest to search for opportunities to connect outdoor learning to existing lessons and subjects to overcome a lack of time. A teacher for instance wrote: *‘As an expansion after a method lesson on nature (3B1S)’* and another *‘Relate the benefits from real-life learning outside to subject matters indoors (3B1S)’*. In contrast, a few other teachers do not explicitly connect outdoor learning to a singular lesson, but focus on being aware for spontaneous moments during outdoor time to inspire outdoor learning. A teacher for instance suggested: *‘Do not schedule an outdoor learning activity, but be aware for spontaneous moments (1B2S)’*.

Barrier: Lack of communal structure

Some teachers feel hindered by not knowing when they can use the green schoolyard. A teacher, for instance, wrote down as a barrier: *‘For me it was unclear for a long time at what moment my class could go outside in the schoolyard (4B4Z)’* and another *‘I could not do anything, my colleague cleared out the garden before I could start (4B8Z)’*. Further, a lack of structure on how to use and share the green schoolyard for outdoor learning can lead to frustrations and uncertainty when teachers do go outside. A teacher wrote down as a barrier: *‘Things that children built, were demolished later [ed. by other teachers and children] (4B4L)’*

and another experienced '*It was overcrowded due to other classes that were outside (2B6LA)*'. For other teachers, the lack of structure results in frustrations on sharing materials. As a teacher explains as a barrier: '*Keeping materials in line. I borrowed something to a colleague, and that is now in her classroom and I am standing with empty hands (5B4LA)*'. Lastly, some teachers experience it as a barrier that there is no clear idea on what outdoor learning is and how it should be formalized within their school as an organization. A teacher for instance wrote down as a barrier: '*To me it is unclear what we want with it [red. outdoor learning]. It is a blanc spot on the horizon, but how do we fill that spot and why in that manner? (5B1Z)*'.

Solutions to overcoming a lack of structure

Teamwork

Teachers addressed a lack of structure by making rules on using the green schoolyard and organizing materials together as a team. They for instance wrote down: '*We made clear rules (4B4L)*' and '*Organize materials (4B5S)*'. Teachers also find it helpful to exchange ideas with colleagues, a teacher for instance wrote down as supportive: '*Discuss with colleagues: Is a child always allowed to work outside? (5B6S)*'.

Develop a common framework

In one particular school it was observed how a pioneer with a decisive mind, sets in motion the development of a communal structure to establish outdoor learning in the green schoolyard. He wrote down as supportive: '*Lack of structure inspired me to develop a framework myself (5B3S)*'. In one of the meetings he took the initiative to share his idea on working with so called 'outdoor learning cards'. These are cards with outdoor learning assignments that are related to subjects in the existing curriculum. Assignments in particular stimulate real-life hands-on experiences in the green schoolyard, for instance related to

mathematics, language or creativity. During free hours, children can choose independently to go outside with a learning card together with another child.

Inspired by his idea, a group of colleagues took on the responsibility to further develop this framework and motivate colleagues to go outside and experiment with the outdoor learning cards. This seems to work, as the team responded positively and found the framework supportive to go outside and start realizing outdoor learning. Teachers for instance wrote down as supportive: *'The format of our colleague (5B6S)'* and *'There is a clearer framework to work with (5B6Z)'*. Teachers also reported enjoying to notice how outdoor learning becomes a more natural part of their daily practice by implementing the outdoor learning cards. A teacher for instance wrote down as motivating: *'To see what is all happening. And most of all.. what we consider to be normal in outdoor learning (5B6L)'* and *'Children now can choose to do outdoor learning activities (5B6L)'*. The development of the framework seems to provide a foundation to further integrate the green schoolyard as a learning environment.

Theme 2: Lack of confidence in one's own outdoor teaching expertise

A recurrent theme concerns teachers reporting feelings of insecurity related to their own expertise as an outdoor teacher during outdoor learning activities. Within this theme, we distinguished the subthemes: fear of losing control and difficulties in managing children's behavior as two closely related barriers. To strengthen confidence in outdoor teaching expertise we observed three common solutions: Familiarize with outdoor learning, organization and rules, and altering one's teaching attitude.

Barrier: Fear of losing control and difficulties managing children's behavior

One aspect that teachers find difficult is how to cope with not being able to see every child at all times during outdoor learning activities in the green schoolyard which makes it

difficult to guard children's safety and manage their behavior. Teachers for instance wrote down as barriers words such as: *'Overview (5B4LA)'* and *'Surveillance (4B6LA)'*, and another teacher illustrates *'[red. children] out of your sight. Parents are worried about this (5B4LA)'*. Teachers are used to an indoor setting in which the rules are clear, outdoors they are faced with a less structured learning environment. Not every teacher immediately feels competent to cope with this learning environment. A teacher for instance expressed as a barrier: *'Space and overview is sometimes difficult due to all the different areas (2B4LA)'* and another *'It is more difficult to address children (5B4LA)'*. Teachers struggle with not knowing to which extent they can trust children's behavior outside. As teachers illustrate as barriers *'Measuring the size of the pond. Children are out of my sight, will they stay dry? (5B2L)'* and *'What can you expect from children (5B2LA)?'*.

Some teachers struggle with safety and risk issues. They find it difficult to balance between warning and protecting children on one hand, and on the other hand allowing children the space to explore and take risks. A teacher for instance wrote down as a barrier: *'Warning for accidents is like a second nature. I need to learn how to restrain myself. As I often experience that it is not necessary (4B3LA)'* and another teacher expressed to finding it difficult: *'To see how children are taking risks, climbing in trees etc...(4B3LA)'* and another *'Twigs are interesting and fun to play around with, but we also need to be attentive for risk (3B3LA).'* In addition, teachers experience that the level of independence you can trust a child with, differs between children. As a teacher for instance wrote down as a barrier: *'Some children break the rules we have made, some children adhere to the rules (5B6LA)'*.

Teachers also find it difficult to manage children's behavior in a way so that all children will be engaged in the outdoor learning activity. Teachers attribute this problem partly to children being unfamiliar with outdoor learning. One teacher for instance wrote: *'I did not do it, my group was not ready yet (4B4Z)'*. In addition, teachers themselves are unfamiliar with

how to guide children during outdoor learning activities. A teacher for instance wrote down as a barrier: *'Guiding the children (5B6L)'* and another *'Management of the class. How can I stimulate free situations or invite children to behave freely, quietly and motivated? (3B3L)'*.

In particular at one school teachers further reflected on a lack of confidence in their own expertise to generate and hold children's attention during an outdoor learning activity. A teacher for instance described as a barrier: *'Too many children under your guard, difficult to keep children involved (4B7LA)'* and another *'To go outside with the entire class, difficult to divide your attention (4B5LA)'*. Furthermore, teachers experience difficulties in coping with children being attracted by the green schoolyard in a way that distracts them from the instructions or lesson they had scheduled as a teacher. A teacher for instance wrote down as a barrier: *'To give instructions at the schoolyard. There are a lot of distractions for the children (4B7LA)'* and another *'Concentration of the children. This was sometimes diminished because they saw little insects or heard the sounds of for instance an ambulance or cars (4B8LA)'*. This further shows how there can be a mismatch between the teachers' intentions and what triggers children during an outdoor learning activity or what children need to get engaged. As a teacher illustrates: *'It is difficult to stay together as a group. Children were looking for things that caught their interest (4B8LA)'* and another *'For some children an open assignment is too difficult. Running around, behaving crazy or really not being capable to make a choice (4B5LA)'*. Furthermore, some teachers first consider it necessary to familiarize with their group indoors, before they can start with outdoor learning. A teacher for instance wrote down as a barrier: *'It is the beginning of the schoolyear, I am still unfamiliar with the children (4B4LA)'* and *'There are also three new children, who do not know each other'(4B4LA).*

Solutions for strengthening confidence expertise as an outdoor teacher

Familiarize with outdoor learning

Some teachers organized small step activities first that allowed children and themselves to familiarize with outdoor learning in the green schoolyard. Teachers for instance did an exploratory walk with children around the schoolyard, let children draw their favorite place in the schoolyard, or had a lunch or reading moment outside. A teacher for instance wrote down as supportive: *'We took the period until the fall to familiarize children with the garden (4B4Z)'* and another *'With the children we did a tour in the garden, we explored what there is and how they can deal with the materials (4B4Z)'*. Furthermore, some teachers trust on repetition as to let children adjust to outdoor learning and let it become ordinary: *'Assure regularity within the activities, so it becomes normal for the children (4B8S)'*.

Organization and rules

Other teachers try to overcome a fear of losing control, by making rules and organizing outdoor learning. Teachers, for instance, discuss with children what is allowed and what is not during outdoor learning. As a teacher wrote: *'Discuss with children what surprised them in the schoolyard, but also about what you can and cannot do with loose branches (3B3S)'* and *'Talk about it with the children (4B4S)'*. In addition, teachers find practical solutions to guard children's safety by, for instance, assuring that younger children cannot open the fence. Furthermore, some teachers organize their instructions inside or find a paved, enclosed spot in the schoolyard to hold instructions. A teacher for instance wrote down as supportive: *'Now and then I am in the 'circle' with my children, and I notice that I need this paved spot for instructions (3B3Z)'*. Lastly, some teachers organize their outdoor learning in smaller groups of children, or only go outside if they have assistance from a colleague. A teacher for instance wrote down as

supportive: *'Intern and teachers outside. One group can play, the other group is in the garden (4B5S)* and another *'Smaller group, divide (2B4S)'*.

Altering one's teaching attitude

Some teachers express how they learned to alter their own teaching attitude. They state that a key to cope with a fear of losing control is to trust on children's independence and own sense of responsibility. A teacher for instance wrote down as supportive: *'Trust children that they can independently work outside on an assignment together (5B4S)'* and another *'Let children go, and trust on their own responsibility (4B6S)'*. Teachers in this sense, find a solution by increasing their own competence as a teacher to trust children and reflect on their own actions as a teacher to control and warn for risks. A teacher for instance wrote down as a key: *'Be aware of your own actions, so you learn to diminish warning for risks (4B3S)'*. During a meeting, a teacher further reflects on this issue of coping with risks by explaining: *'Most children know how far they want to go and stop for example with climbing a tree when they go to high. Risks are mostly in the environment, not in the child (4B4Z)'*. Instead of focusing on their own fear to stay in control, these teachers focus on what is beneficial for children to learn outside in regards to risk taking and developing independence. In response, some teachers enjoy and feel motivation by their experiences that they indeed can trust children and observe how children are working on their own outside, as illustrated by remarks that: *'Children adhere to the rules (5B6L)'* and *'Children collect the materials on their own (5B6L)'*.

To overcome barriers related to managing children's behavior, some teachers reframed the question 'what is distracting children' to 'what is attracting children outside'. They have an open and curious attitude, and become observant to children's experiences in the green schoolyard. A teacher for instance explains *'I have read with several children in the schoolyard and this helped me to further understand how children experience the outdoor environment.'*

This supports me to further develop and experiment with outdoor education (4B8Z)' and another teacher wrote down that she has been *'Observing how children experience the garden (4B3Z)*'. By actively participating and playing with children, some teachers hope to attract children's attention to an outdoor activity through their own enthusiasm and sense of wondering. As one teacher wrote: *'By being really enthusiast about something, for instance looking at a mushroom with amazement or a yellow leave, you help the children to get engaged (4B5S)*' and *'Be enthusiast yourself (4B7S)*' and *'Play along (4B5S)*'. In particular, this holds for children who have more difficulty to get engaged in an activity themselves. Furthermore, some teachers experience active participation as supportive to directly adjust their teaching style to children's experiences: *'Actively participate myself. This allowed me to address children directly, stimulate them and resulted in interaction (4B3S)*'.

Theme 3: Difficult to get started

In particular in the beginning, when teachers have little to no experience with outdoor teaching, some teachers experience it as difficult to start with realizing outdoor learning in the green schoolyard. A teacher for instance wrote down as a barrier: *'Getting started is the most difficult part (5B2LA)*' and another teacher describes it as difficult *'To actually do it (5B3LA)*'. Furthermore, a few teachers find it difficult to get started themselves, they want to await and first experience how colleagues initiate outdoor learning activities. A teacher for instance wrote down: *'I hope to be caught by the enthusiasm of others – of pioneers (5B1Z)*' and another *'First see which way the wind blows (3B1Z);'*. In addition, some teachers feel too uninvolved with the concept of outdoor learning to stay engaged in a process of becoming an outdoor teacher. A teacher for instance wrote down as a barrier *'Outdoor learning is not on teachers' mind in the higher grades (5B3LA)*' and another *'I cannot adequately empathize with this form of education, so I see almost no development [red. in my own activities]. (3B3LA)*'.

Solutions to getting started

Decisive mind

Teachers who feel hindered to get started by outdoor learning not being formalized, express that a decisive mind supports them to overcome this barrier. Teachers for instance report that *'Do it (5B2S)'* or *'Just start (5B2S)'*, and *'Instead of awaiting, make choices (5B2S)'* supported them to go for it, to get engaged in first activities and formalize outdoor learning themselves. A decisive mind is further characterized by *'Enthusiasm (5B2S)'*, *'Feeling convinced (5B2S)'* and *'Perseverance (4B8S)'*. This supports teachers to not give up after one activity, but continue to formalize outdoor learning despite of barriers they experience.

Step by step

Teachers suggest to take a first small, demarked and feasible step, and trust that step by step they will realize outdoor learning, as expressed by remarks to *'Keep it small (4B1S)'* and *'Trust, small steps also make a journey (5B1S)'*. In addition, some teachers find it supportive to, as a first step, start indoors with a lesson that is related to the outdoor environment by bringing nature elements into their classroom. Teachers for instance suggested, *'Walking stick bugs in the classroom (3B2S)'*, *'Starting indoors (2B5S)'* and *'Only indoor sowing and planting (2B6Z)'*.

Inspiration

Some teachers report inspiration with ideas on outdoor learning activities as a solution to overcome the hindrances of a lack of pre-structured lessons and methods for outdoor learning. *'A ready-to-use package with bulbs that a parent provided (3B1S)'* and *'Inspiration from other persons (3B3S)'* supported them to start with a first outdoor learning activity. In a

later stage, a teacher mentions how you can get inspired by the environment to formalize outdoor learning, and another that it is important to free time to get inspired.

Pioneers

Previously we observed how in a particular school a pioneer set in a chain reaction of activities in other teachers to formalize outdoor learning. At other schools, teachers also described activities of *'A positive colleague who takes initiative (3B2S)'* and *'The spontaneity with which my colleague is going outside (4B8I)'* as a motivation to get started. The *'Chain reaction (5B2Lk)'* of outdoor learning activities, as one teacher described is, is not only supportive, but teachers also describe it as a *'Catching (5B2Lk)'*.

Theme 4: Physical constraints

Teachers report frustrations about the maintenance, in particular with the rapid deterioration of the green schoolyard. A teacher for instance wrote down as a barrier: *'Quick deterioration of the green play hill (3B1LA)'* and another *'Rapid decay of the green schoolyard (3B3LA)'*. Teachers experience it as difficult to protect the green schoolyard to children's behavior. A teacher for instance wrote down: *'I brought a plastic white rose. This symbolizes how I love roses and enjoy to look at them. Our green schoolyard is being trampled and my rose withers (3B2Z)'*. Furthermore, some teachers experience that the green schoolyard is not 'green enough' for outdoor learning. A teacher for instance wrote down as a barrier: *'There are not enough green materials in our schoolyard (3B3LA)'*.

Weather conditions are also mentioned as a physical barrier by teachers across all meetings. In most occasions this concerns teachers who canceled an outdoor activity due to rainfall or stormy weather conditions. As a teacher for instance wrote down as a barrier: *'I brought a drawing of bad weather. This symbolizes the mathematics assignment I postponed.'*

There was too much rain and wind (3B2Z)'. A few teachers mention specifically that certain seasons make outdoor learning more difficult, this was mentioned by teachers during the winter season. A teacher for instance wrote down as a barrier: *'The season impedes outdoor learning activities (4B6LA)*'.

Solutions to overcome physical constraints

Preventing child erosion

To protect green areas against the so called child-erosion, teachers find a practical solution. For instance, teachers placed: *'A red and white ribbon (3B2S)*' to protect flower bulbs. Furthermore, the team took upon initiatives to green their schoolyard with more natural materials, such as getting *'New plants through sponsoring (3B3S)*' and *'Bring materials myself, for instance 30 pineapples (3B3S)*'. The team mentioned commitment to maintenance as important and enjoyed to further design their green schoolyard together.

Dealing with weather conditions

Whereas rainfall and stormy weathers are mentioned as a barrier, sunny weather is considered inviting and supportive to go outside. Teachers for instance reported: *'Go outside, it is springtime! (5B6Z)*' and *'Nice weather for the garden (5B1L)*' and *'Schedule in outdoor lessons but wait until the weather becomes a bit warmer (4B6S)*'. Teachers who felt hindered by bad weather conditions, did not report on keys to overcome rainfall and stormy weathers. However, teachers do describe how experiences with seasonal influences in the green schoolyard inspired their outdoor learning activities. A teacher for instance observed with her children a chestnut tree across the seasons, as she wrote down *'Chestnut tree: we experienced all seasons! Bold, buds, leaves, autumn colors and chestnuts! (3B3Z)*' and *'Making fat balls for birds in January and February (4B6L)*'. In another school the children made Christmas trees

and decorations in the schoolyard with natural materials during the winter season. Still, fall and spring season seem easiest for teachers to experiment with outdoor learning. Heaps of leaves, chestnuts and other natural materials in the fall, for instance inspire creative learning activities, such as ‘*Crafting an autumn wreath with natural materials (4B6Z)*’ and ‘*An Autumn craft corner (4B5Z)*’. In springtime, teachers observe with children the emerging and blossoming nature and sow, care and harvest kitchen gardens. As teachers, for instance, wrote down: ‘*A free assignment: What has grown in the last week? (4B3Z)*’ and ‘*Sowing and transpire. To observe the peas growing (5B6L)*.’ and ‘*Harvesting the grapes and eat them on a nice spot in the sun (2B4S)*’.

Discussion

In this study we present data from a collaborative action research project called ‘Becoming an outdoor teacher’ in which we investigated barriers experienced by primary school teachers to facilitate outdoor learning in the green schoolyard and solutions to overcome these barriers across a period of two consecutive years. Results revealed four broad themes encompassing barriers and solutions. The first theme included three barriers related to outdoor learning having no formal status in teachers’ current educational practice: unfamiliarity and a lack of inspiration, lack of time, and lack of communal structure. The second theme include two, interconnected, barriers related to a lack of confidence of teachers in their own outdoor teaching expertise: fear of losing control and difficulties managing children’s behavior. The third theme related to the barrier of finding it difficult to get started. The fourth theme related to physical constraints as posed by a lack of maintenance and weather conditions. These barriers are largely similar to those identified in previous studies by, for example, Dyment (2005); Maynard and Waters (2007). However, a main contribution of the present research is that barriers were identified through a collaborative action approach, in which teachers,

professionals and researchers identified barriers through a process of systematic reflection on teachers' real-life experiences. Moreover, the collaborative action approach challenged teachers, professionals and researchers to come up with solutions to overcome barriers and realize outdoor learning in the green schoolyard. This provides meaningful data that are grounded in teachers' daily educational practice.

To conquer the 'daunting task' (as it was previously called by Dymont and Reid (2005)) of realizing outdoor learning in the green schoolyard we identified several solutions that can support teachers to overcome the barriers related to each specific theme. With respect to the lack of formal status of outdoor learning (theme 1), as a solution to the barrier of unfamiliarity and a lack of inspirations, teachers found support in the organized inspirations moments, working together with colleagues, and to engage in real-life experiences and observe children's positive reactions to outdoor learning. Teachers experienced that the barrier of a lack of time can be overcome by making a conscious decision to make time for outdoor learning, and to connect outdoor learning to existing lessons in the curriculum. To overcome a lack of communal structure, teachers also found teamwork helpful, as well as the bottom-up development of a common framework for outdoor learning. With respect to the lack of confidence of teachers in their own outdoor teaching experience (theme 2), teachers experienced that fear of losing control and difficulties managing children's behavior can be overcome by familiarizing children with outdoor learning, making rules and organizing outdoor learning, and altering one's own attitude as a teacher. To overcome difficulties to get started (theme 3), a step by step approach, inspiration, a decisive spirit, and teamwork were found to be supportive. Finally, to deal with adverse physical conditions related to maintenance and weather (theme 4), teachers found support in practical solutions to prevent child erosion. Although teachers did not experienced a solution to overcome rainfall and stormy weather

conditions, they did find support in sunny weather and found inspiration for outdoor learning in experiences with seasonal influences.

General recommendations

In addition to the specific barriers and solutions, some general recommendations for what is needed to realize outdoor learning on green schoolyard can be derived from the present research.

Just do it

First, previous studies that theorized on what teachers need to realize outdoor learning mostly suggest the idea that teachers need to adopt a new pedagogical outdoor mindset (Dyment & Reid, 2005; Maynard & Waters, 2007; Passy, 2014; Waite, 2011). Although this sounds obvious, changing a mindset is difficult and costs time, which is scarce in current educational practices. Alternatively, the present research suggests that, when outdoor learning is yet another additional thing on the work load, the simple answer might be: just do it. There is a certain aspect of a decisive mind in some of the teachers. Despite all the barriers, despite the lack of time, despite the realities of their educational practice, they take a first step and go for it. Sometimes teachers were even surprised by their own actions. They did it, against their own odds. Schedule it in, prepare, connect outdoor learning to an existing subject, and collaboration with colleagues are some aspects that support this decisive mind. This decisive mind corresponds to a previous study in which ten primary school teachers in Scandinavia were interviewed who gained some experience in the so called ‘udeskole’ (teaching outside the classroom). Results showed that teaching outside can stimulate a feeling of regaining one’s professionalism (Barfod, 2017). However, the freedom and autonomy also create a double-edge sword as it puts a challenge on one’s professional judgment as a teacher. We also observed how

teachers can enjoy to use their skills and knowledge as a teacher to create outdoor learning, and at the same time can feel hindered by feelings of incompetence in regards to their unfamiliarity with outdoor learning and a lack of confidence in their outdoor teaching skill. In general, deciding that outdoor learning is a worthy part of one's educational practice and just do it can be a supportive strategy to realize outdoor learning, but this also sets in motion a professional developmental process that brings to light doubts about one's own competence and skills.

Get educated and inspired

Second, we observed how inspiration moments and guided hands-on experiences can support teachers to familiarize themselves with the concept of outdoor learning, and opens up their awareness of opportunities to incorporate outdoor learning in the green schoolyard in their educational practice. In this sense, it seems of particular importance not to limit inspiration moments to ready-to-use lessons, but to combine theoretical background and real-life experiences aimed to stimulate a carry-over effect to teachers generating their own pedagogical ideas and meaningfully incorporate the green schoolyard as an outdoor learning environment in their educational practice. Only handing out concrete ideas for outdoor lessons can lead to a one-dimensional use of the green schoolyard and a failure to strengthen teachers' professional judgment and competence. This can lead teachers to simply asking 'what's next', and outdoor learning will risk to cease to exist when the inspiration flow stops or all the lessons are carried out. This adds to a previous study that explored strategies that are effective to facilitate learning in a natural environment and stretch the importance of teachers' understanding the reason for visiting an outdoor location and having appropriate exercises to guide children in a meaningful learning process (Ballantyne & Packer, 2009). Without insight in the value and background of outdoor learning, time spent in the green schoolyard will be no more than a change of scenery instead of an enrichment of children's learning experiences.

Engage in real-life experiences

Third, the importance of learning and inspiration goes hand in hand with the importance of real-life experiences in teachers' educational practice and reflection on these experiences. Simply stated: teachers do not realize outdoor learning by staying indoors. They need to be stimulated to go outside, to experiment, to incorporate the green schoolyard as a learning environment through hands-on learning themselves. This builds upon previous research of Hickman and Stokes (2016) who evaluated outdoor leader education and training, and suggest the importance of reflecting on experiences in teachers' daily practice to further professionalize and develop outdoor education skills. During teachers' experiences, barriers become more vivid compared to barriers that you can imagine. As teachers sometimes experienced that what they were afraid of, turned out to be different in real-life and vice versa. In addition, hands-on learning goes beyond acquiring physical and technical skills and supports the development of broader and holistic skills. In this there is a similarity between the characteristics of outdoor learning and what supports teachers to become an outdoor teacher. Through experiences outdoor education becomes alive, and teachers' understanding and competence can be shaped and strengthened through practice. This is in line with previous research that discusses how outdoor learning can re-awaken joy in teachers (Waite, 2011).

Get an outdoor pedagogical mindset

Fourth, we observed that, although a controlling mindset based on fear of losing control and managing children's behavior, can be successful to a certain extent, it also entails a risk of a negative impact on the educational process. Stan and Humberstone (2011) observed in an ethnographic study teachers' behavior during outdoor education, and found that a controlling approach in order to manage risks during outdoor education limited learning opportunities for children. A different approach, in which teachers become observant to what attracts children in

the green schoolyard, actively participate with the children and aim to understand the value of their (risky) behavior and guide learning activities, seems to open up learning situations for the children. This builds upon previous studies, which suggest the need to develop a different attitude in which teachers loosen their indoor need for structure, and are open and curious to the opportunities of the unstructured green schoolyard (Dyment, 2005; Sahrakhiz, 2017a). Still, it remains somewhat unclear why some teachers embrace a more open mindset and other teachers hold on to indoor controlling strategies. One explanation could lie in teachers' and schools' vision on education and the school culture in this regard (Passy, 2014). Future research could extend our collaborative action research approach by observing and measuring the impact of teachers' outdoor activities and behavior during these activities, and in reflections discuss these experiences in the context of their vision. This could further untangle what defines an outdoor pedagogical mindset, what supports teachers to develop this and how their behavior can be grounded in a vision on (outdoor) learning.

Follow a tailored process

Lastly, although most barriers are observed across schools, not every teacher has to experience or go through every barrier, and they may experience different barriers in different orders or phases. There can be differences between schools, but also differences within teachers at the same school. For instance, in one school the emphasis was on developing a communal structure for outdoor learning and at another school managing children's behavior was a major concern. In addition, while some teachers have ideas but find it difficult to make time for outdoor learning, others can struggle mostly with feelings of didactical incompetence. This reveals that becoming an outdoor teachers refers to a certain extent to a personal and organizational development. This implies that supporting teachers to facilitate outdoor learning in the green schoolyard requires a tailored process and there is no one-size-fits-all solution. This

further builds on previous research that discusses differences between teachers in their willingness and capabilities to teach outdoors (Passy, 2014; Waite, 2011). Apparently to some teachers it becomes more natural to use the green schoolyard as a learning environment, while others are more hesitating to go outdoors. Interestingly, in a team it can become a strength that some teachers more naturally dare to get started and undertake outdoor learning activities in the green schoolyard. When sharing and making their activities visible to their colleagues, they can inspire and enthuse them to do the same. Furthermore, together as a team developing outdoor learning in the green schoolyard can be a valuable contribution to the school as an organization (Sahrakhiz, 2017b).

Strengths and limitations

To our knowledge, this is the first project that aimed to identify solutions that support teachers to overcome barriers and realize outdoor learning in the green schoolyard, and in which teachers were followed for two consecutive years. The collaborative action research design stimulated the development of hands-on knowledge of which teachers participating in the project directly benefitted, and that can be extended to other primary schools on a national and international level. However, the research is not without its limitations.

First, primary schools participating in the project were open to devote time to facilitate outdoor learning in the green schoolyard. This could have led to a self-selection bias, in which outcomes could be different in more reluctant schools. However, barriers observed are similar to those in previous studies in different countries. Furthermore, participating in the green schoolyard meetings was not without struggles. Despite a decision to participate in the project, teachers were often faced with other responsibilities that required their attention. In some occasions this led principals to decide to cancel meetings or to, in one situation, prematurely

abandon the project. Although disappointing, this reflects a realistic situation of circumstances in which teachers need to establish outdoor learning.

Second, schools differ in the number of meetings and teachers participating in every meeting, and the designs of their schoolyards. In particular at one school, the type of greening and maintenance formed a barrier to realize outdoor learning. However, in qualitative research it is not about the quantity of measurements, but the content is leading. Still, to account for differences between schools, we first aggregated findings within schools and next triangulated our findings across schools. As shown, similar themes arose, but also differences between schools. These differences suggest a tailored process of becoming an outdoor teacher. Future research could devote attention to differences between schools and explore, for instance, whether these difference find their origin in the type of education, personality of teachers or design of the schoolyard. For example, selection of schools based on systematic variations in school type and design or a procedure of co-analysis with teachers could account for these aspects.

Third, despite the fact that we observed teachers overcoming barriers and in all schools outdoor learning activities emerged, the project is not solely a success story. During and after the project barriers continued to exist and teachers kept struggling with outdoor learning having no formal status and their own feelings of incompetence. However, a change has been set into motion and it is up to teachers to further trust on and strengthen their professional judgment. The supportive aspects found in the project can support teachers to continue their process. In addition, future research could support teachers by further investigating the impact of outdoor learning activities in the green schoolyard on children's development and what constitutes a beneficial outdoor learning experience. As insight in the evidential value of outdoor learning can support teachers and institutions to acknowledge the green schoolyard as an outdoor learning environment and empower the formal status of outdoor learning.

Conclusion

As a first project to explore what teachers need to facilitate outdoor learning in the green schoolyard, we hope to have set the stage for future research in unraveling the professional qualities of an outdoor teacher and the characteristics and value of outdoor learning in green schoolyards. Altogether, our research suggest that trusting on one's professional judgment, taking the time and just doing it, getting educated and inspired, embracing an outdoor pedagogical mindset, engaging in real-life experiences and reflecting on these experiences can support teachers to step by step establish outdoor learning in the green schoolyard. Furthermore, our findings imply the importance of understanding why outdoor learning should be facilitated and stress the importance of teamwork.

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6

Chapter 6

General discussion

Between the start of the project and the final writing of this thesis, the trend of greening schoolyards rapidly expanded. In the last few years, in The Netherlands, a province, for instance, decided to green *every* schoolyard in their region. Within the next few years, a tremendous number of children will be able to have daily access to a dose of nature contact. Something unthinkable only 15 years ago, when the term ‘nature-deficit disorder’ was introduced by Richard Louv (2005, 2008) to describe the negative health impacts of children’s growing alienation from nature. As I started in the introduction with the question of why we allow our children to grow up deprived of nature, could it be that in the meantime, our society is changing? That the importance of access to nature is becoming to be (re)valued amongst parents, teachers, and even politicians?

At the same time, urbanization continues to increase and nature areas are still at risk of decreasing and disappearing. So, people seem progressively responsive to the alarming message of Louv (2008), but there is also still a need to continue to explore and voice the importance of nature contact for children’s health and well-being (Gascon, Vrijheid, & Nieuwenhuijsen, 2016; Kim, Lee, & Sohn, 2016). The benefits of nature for children’s well-being and development can easily get lost in economic and other public interests. Greening schoolyards constitutes a promising intervention to provide and guarantee daily access to nature for all children. Regardless of their socioeconomic status and urbanity level of their home living environment (Danks, 2010).

These societal developments highlight the actuality of the concept, but also warrant the importance of a critical reflection on the impact, design, and outdoor learning opportunities of greening schoolyards. As pointed out at the start of this thesis, there is still much left to uncover regarding the benefits of nature contact and, in particular, the impact of greening schoolyards on children’s well-being and development.

Main findings

This thesis aimed to extend the empirical evidence base for greening schoolyards and to provide guidelines for the implementation of green schoolyards in teachers' practices and student education. In general, the findings presented in the four empirical chapters of this thesis speak to a positive impact of greening schoolyards on children's appreciation of the schoolyard, attention restoration, social well-being, and play behavior. Moreover, findings show that parents tend to have a favorable view of greening, and teachers' experiences revealed four themes encompassing barriers and solutions to establish outdoor education on the green schoolyard.

The following sections contain a more detailed discussion of findings in five encompassing themes:

- (1) '*Trapped in the beauty of the design*' describes the robust findings in chapters 2, 3, and 4 that greening schoolyards lead to a higher appreciation of the schoolyards and more varied and inclusive play behavior. However, the findings also highlight that for both outcome measures there is room for improvement, and I discuss how designs probably influenced these results.
- (2) '*Go girls!*' focuses on the indications in chapters 2, 3, and 4 that greening, in particular, seems to stimulate girls to become more physically active and engaged in play behaviors during recess.
- (3) '*The curious case of children's attention span*' refers to findings in chapters 2 and 4, which show support for a positive impact of greening on attention restoration. I aggregate these findings with experiences from teachers in chapter 5. During outdoor

learning, they observed that learning, children's attention is often drawn towards (or distracted by) nature-based features in the environment.

- (4) *'The impact of greening on children's social well-being'* merges the mixed findings of chapters 2 and 4 regarding the impact of greening on children's social well-being.
- (5) *'Not solely a green schoolyard, but a green school'* summarizes practical implications distilled from chapters 4 and 5 to ongoing invest in a green schoolyard and maximize its potential as an outdoor learning environment.

Theme 1: Trapped in the beauty of the design

Two robust and consistent findings reported in this thesis relate to the positive impact of greening on the appreciation of the schoolyard and children's play behavior.

The impact of greening schoolyards on appreciation

Concerning the appreciation of the schoolyard, the prospective intervention study in chapter 2 shows that after greening the schoolyard, children perceived the schoolyard as more natural and attractive, and they gave it a higher numerical score. In a similar vein, results from chapter 4 show that parents from schools with a green schoolyard evaluate their schoolyard more positively on the same outcome measures as the children, compared to parents from schools with a paved schoolyard. These convergent findings reflect those of previous studies that show that children prefer to play in natural areas and have more positive perceptions of green compared to paved schoolyards (Jansson et al., 2014; Lucas & Dymont, 2010; Samborski, 2010). However, although greened schoolyards were appreciated more than paved schoolyards, both children and parents are not extremely positive. Likeability scores, for instance, measured on a 10-point scale improved from a 6.4 on average at baseline to a 7.1 at second follow-up, so there still seems to be room for improvement.

The impact of greening schoolyards on play behavior

Chapters 3 and 4 show consistent findings for play behavior. In line with previous literature (Bell & Dymont, 2008; Kuh et al., 2013), results from the video-observations of children's play behavior in chapter 3 show that greening schoolyards stimulates children to engage in more play, as compared to non-play, behavior, and stimulates more varied, constructive and exploratory play behavior. Parents in chapter 4 also deem a green schoolyard to be more supportive of varied play behavior compared to a paved schoolyard. However, children still dominantly engaged in functional play and games-with-rules in the newly designed green schoolyards, and the increase in more varied, creative, and exploratory play behavior is small. These results corroborate with previous studies which, for instance, show that children show higher appreciation of green schoolyards, but not necessarily use these areas for play (Andersen et al., 2015; Mårtensson et al., 2014), and show a more extensive variation of play behavior in a green compared to paved schoolyard, but not necessarily more creative play behavior (Fjørtoft, 2004; Jansson et al., 2017).

Limitations in the green designs

The findings presented in chapters 2, 3, and 4 together strengthen the empirical evidence for greening schoolyards by consistently showing that green schoolyards are more highly appreciated than paved schoolyards and positively influence children's play behavior. However the effects were relatively small and after greening the schoolyards were still only moderately appreciated and there was still little variation in play behavior, children mostly engaged in functional play and games-with-rules. The quantity and quality of the designs of the green schoolyards could be a possible explanation for these findings. The re-design only enriched the schoolyards' environmental properties to a limited extent. For instance, as described in chapters 2 and 3, most natural features in the schoolyards were constructed of, but not rich in, loose parts

that allow children to design, re-design, and give meaning themselves. Furthermore, the greening was, in most cases, modest, and there were still paved areas in all schools. The newly (green) features are perhaps somewhat more pleasing to the eye, but in its essence, do not seem to differ that much in terms of affordances children can actualize in their play activities. In this perspective, schools are at risk of being trapped in the beauty of the design, and potentially the presented findings underestimate the potential of green schoolyards.

Theme 2: Go girls!

Another consistent finding that emerges from this thesis relates to gender differences in the impact of greening schoolyards on physical activity and play behavior. In chapter 2, accelero-based measurements of children's physical activity levels during recess showed that greening, in particular, has a positive impact on physical activity levels of girls. In accordance with these objective measurements parents in chapter 4 also consider green schoolyards to enhance the physical activity of girls more than the physical activity of boys. Furthermore, the video observations of play behavior in chapter 3 indicate that, after greening, especially girls become more actively engaged in play behavior during recess. During baseline measures, observations show that girls are predominantly engaged in passive non-play behaviors like conversation and watching boys playing soccer. After greening, girls were more involved in play activities themselves, mainly games-with-rules. Taken together, these results corroborate those of previous studies, which also indicate that greening has a stronger influence on the physical activity of girls than boys (Coen, Mitchell, Tillmann, & Gilliland, 2019; Fjørtoft et al., 2009a; Pagels et al., 2014).

The finding that greening, in particular, seems to bolster physical activity and play behavior of girls might be attributed to the assumption that traditional, paved schoolyards tend to be designed one-dimensional and mostly dominated by the play activities of physically

dominant boys. A consequence of this design can be that girls are systematically excluded from space and play opportunities on paved schoolyards (Brez & Sheets, 2017; Sharma-Brymer & Bland, 2016). As supported by Affordance Theory (Gibson, 1979), greening schoolyards creates a more multi-dimensional schoolyard that better accommodates the interests, abilities, and needs of both boys and girls. The finding in chapter 3 that, although to a lesser extent, after greening the schoolyards, there was a decrease in observed passive non-play behaviors in boys, further affirm this assumption.

Overall, the empirical evidence in chapters 2, 3, and 4 contributes to our understanding of green schoolyards as inclusive and gender-sensitive (Coen et al., 2019; Dymont & Bell, 2008). In this respect, it is also relevant to point out that for other outcomes, such as the appreciation of the schoolyard, attention span and social well-being, there was no differential impact of greening on girls and boys. Hence, it may conceivably be hypothesized that different pathways underlie the beneficiary impact of greening schoolyards on children's well-being and play behavior, and there is no 'one fits all' paradigm to advocate the rationale for greening schoolyards (Herrington & Brussoni, 2015).

Theme 3: The curious case of children's attention span

The idea that greening schoolyards can positively affect children's attention span is rooted in the Attention Restoration Theory (Kaplan, 1995), which posits that contact with an unthreatening natural environment elicits a state of soft fascination in which attention is effortlessly drawn, which allows for the restoration of depleted cognitive mechanisms that direct attention. This thesis found that green schoolyards can foster attention during recess as well as during outdoor education.

Attention restoration during recess

In the context of recess, both chapters 2 and 4 indicate that greening schoolyards indeed can support the replenishment of depleted cognitive resources in children during their morning break at the schoolyard. Chapter 2 shows that at second follow-up, children showed more attention restoration during recess than at baseline, as measured by changes in performance on cognitive tests administered before and after the 15-minute morning break. In chapter 4, although not asked directly, parents also mentioned the restorative quality as an advantage of green schoolyards. This finding holds for both parents from schools with a green schoolyard and parents from schools with a paved schoolyard. These findings are consistent with previous studies showing a positive relationship between exposure to nature and children's attention span (Dadvand et al., 2015; Flouri, Papachristou, & Midouhas, 2019; Reuben et al., 2019; Stevenson, Schilhab, & Bentsen, 2018). Attention span plays a vital role in children's academic performance. However, evidence for a direct link between greenery in and around schools and academic performance is mixed and weak (Browning & Rigolon, 2019). Because the present research did not include any performance measures, it does not further illuminate potential impacts of greening schoolyards on academic performance.

In chapter 3 an increase in unoccupied behavior during recess after greening was observed that may be indicative of enhanced attention restoration. Although this increase in unoccupied behavior may indicate that in the newly designed schoolyard children can feel somewhat lost, it is also plausible that children are purposely wandering around alone. Previous studies also suggest that such behavior allows children to find a private place surrounded by nature to spend some time relaxing and restoring (Chawla et al., 2014; Hart, 1979; Woolley & Lowe, 2013).

Attention during outdoor education

In the case of outdoor education, teachers in chapter 5 who experimented with outdoor learning in the green schoolyard often mentioned how children are more attentive and drawn to natural elements. When asked about their experiences, teachers described how, during outdoor learning activities, children are attracted to, or distracted by, in the eyes of some teachers, natural stimuli that capture and hold their attention. These experiences seem similar to the concept of soft fascination, as described by the Attention Restoration Theory (Kaplan, 1995). However, it seems that in these situations, soft fascination is not the fundament of attention restoration, but rather serves as an effortless trigger for children to engage in child-initiated learning experiences. Teachers repeatedly reported how they observe children being very enthusiastic and how there emerges learning without children feeling obligated that they ‘must learn’. While most teachers experience this as a positive characteristic of outdoor learning in the green schoolyard, for other teachers, it brings about a barrier. They can find it difficult to manage children’s behavior outdoor and struggle to generate and hold children’s attention. These teachers experience, for instance, that children’s attention is drawn to stimuli in the environment of their interest instead of focusing attention on the teachers’ instructions or the activity. Interestingly, teachers find a solution to overcome this barrier by understanding how the natural environment draws children’s attention and adjust their attitude as a teacher to become more curious and open, and actively participate alongside children’s experiences.

Freedom and an action-oriented approach

In general, the concept of soft fascination, as described in the Attention Restoration Theory (Kaplan, 1995), adds to understand how green schoolyards can support children’s attentional functioning during both recess and outdoor education, as in green schoolyards natural stimuli effortlessly capture children's attention. On the one hand, this facilitates

restoration of depleted cognitive resources, and on the other hand, it stimulates ongoing, child-initiated exploration of the environment. Essential is perhaps the freedom for children to emerge in experiences of their own choice effortlessly.

The idea that hands-on experiences are essential to foster a restorative experience in children receives some support from the finding in chapter 2 that greening had a direct positive impact on attention restoration as measured by performance on cognitive tests. However, it did not influence children's perceptions of the restorative quality of the schoolyard. Alternatively, it is also possible that the questionnaire we used to assess perceived restorative quality was not sensitive enough to detect changes in the schoolyard. Indeed, concerning the latter suggestion, it should be pointed out that the used questionnaire relies heavily on adult conceptualizations of restoration (Bagot et al., 2015). Adults' perceptions of restorative quality tend to be guided mostly by physical features of settings and mental simulations of previous restorative experiences. In contrast, for children, restorative quality seems to be more a function of what they can do in an environment, than how the environment looks like (cf. Heft, 1988). Thus, measuring children's perceptions of restorative quality may require a more action-oriented approach.

Altogether, various findings in chapters 2, 3, 4, and 5 suggest that greening schoolyards can have a positive impact on children's attention span. Both in their influence on attention restoration during recess to pay attention to classroom-based learning, as well as to generate and hold children's attention during child-initiated outdoor learning activities. The mechanisms underlying these findings remain, however, somewhat unclear, and it would seem imperative to further evolve theoretical understanding regarding the impact of nature contact on attention restoration in children.

Theme 4: The impact of greening on children's social well-being

This thesis only partially supports previous observations of a positive relationship between nature contact and children's social well-being (Chawla et al., 2014; Chawla & Nasar, 2015; Hartig, Mitchell, de Vries, & Frumkin, 2014). In particular, empirical findings on the impact of greening schoolyards on children's pre- and post-measures of social well-being in chapter 2 appeared to be somewhat mixed. This chapter shows that at baseline, children at the intervention schools, in general, reported lower levels of social support compared to children in the control schools, while at follow-up, these differences had disappeared. This finding indicates that greening schoolyards can support children who are in need to develop positive friendships. Also, chapter 2 provides some support that greening schoolyards can foster prosocial behavior amongst younger children (grades 4 and 5), as indicated by a higher percentage of children behaving prosocially on a Social Orientation Choice Card task. However, these findings are not replicated in self-reported levels of prosocial behavior and seem to hold only at first follow-up.

In chapter 4, parents and caregivers did not recognize the positive impact of green schoolyards on social behavior. This result contradicts previous findings and may be related to parents not being informed on the possible benefits of schoolyard greening on children's social well-being.

When thinking openly about the disadvantages of green schoolyards, some parents in chapter 4 mention concerns regarding a lack of overview of teachers, which brings about the risk that children can hurt each other out of the sight of the teacher. These concerns are similar to some teachers' experiences in chapter 5. Teachers find solutions to solve this issue by making rules with the children and trusting children's independence. Furthermore, some teachers can also find it challenging to go outside if they are not confident about the group dynamics in their class. However, teachers also report on the benefits of outdoor learning in green schoolyards

on group dynamics throughout their experiences in chapter 5. Teachers, for instance, experienced how outdoor learning can have a positive influence on group dynamics and foster cooperation amongst children. These experiences correspond to previous studies that show positive relations between outdoor learning and social development (Hartmeyer & Mygind, 2016; Waite et al., 2016).

Altogether, the research presented in this thesis gives some indications that greening schoolyards can be beneficial for children's social well-being. However, the findings are somewhat inconsistent and require further exploration. To some extent, the mixed findings regarding social well-being may be due to a lack of knowledge on the kinds of benefits that a green schoolyard can bring about. It may be useful to increase in particular parents', but also teachers' awareness of the potential benefits of nature contact for children's social well-being and development.

Theme 5: Not solely a green schoolyard – But a green school

Greening a schoolyard is not a single, one-time event. Although in most schools re-designing a schoolyard with natural features is restricted to the schools' outdoor environment, its creation often affects the school on a broader and deeper level (Danks, 2010). Chapters 4 and 5 provide practical insights to support the implementation of green schoolyards in a school's organization and curriculum.

Organizational challenges

At an organizational level, greening confronts schools with the design and maintenance of the schoolyard. Previous work has shown that parental involvement can be an essential facilitator in this regard (Van Nispen tot Pannerden, Tegels, & Van Laar, 2014). Chapter 4 provides useful insights for setting up fruitful collaborations with parents by showing that

parents hold positive perceptions on the benefits of green schoolyards. Still their opinions can be informed by more direct experience with the benefits of green schoolyards. It seems in particular relevant to share experiences from parents from schools that already have a green schoolyard, with parents from schools that are about to green their schoolyard. In addition, chapter 4 reveals that parents acknowledge disadvantages in terms of risks and dirty clothes, but also express to have no real problems with this.

To organize parental involvement, schools should be aware of the needs, interests, and capabilities of parents. Their willingness to help is limited, and parents are more interested in helping with activities than in helping with maintenance. As a first step to motivate parents to help with maintenance, help with activities could be a good starting point.

The willingness of some parents in chapter 4 to help with activities corresponds directly to the need expressed by some teachers in chapter 5 for parental support in realizing outdoor learning activities in the green schoolyard. Some teachers expressed it as a solution if there would be an extra person, a parent, present during outdoor learning to assist in supervising the children. In particular, to overcome barriers related to a lack of overview.

Altogether, in agreement with previous work on parental involvement in children's education and school lives, these findings implicate the importance of open communications between parents and schools, and awareness for parent's needs and capabilities in maintaining and utilizing the schoolyard (Hornby & Lafaele, 2011; Pushor & Amendt, 2018).

Outdoor learning opportunities

Greening schoolyards not only creates the need for organizational initiatives, but it also opens up a new world of outdoor learning opportunities. In chapter 5 it is explored how teachers can seize the opportunities afforded by greening schoolyards to integrate outdoor learning in their educational practice. While realizing outdoor learning, teachers feel hindered by their

experience that outdoor learning has no formal status in current educational practices. To utilize a green schoolyard to its potential, a transformation in thinking about education and the value of outdoor learning seems unavoidable. This observation corresponds to writings from previous authors (Davies & Hamilton, 2018; Passy, 2014; Waite, 2011), and becomes further evident in teachers' finding a solution in embracing novel outdoor pedagogical ideas.

Chapter 5 provides further insight into aspects that can support primary schools in realizing a green schoolyard to its educational potential. The findings together provide a picture of a step by step process, in which teamwork, real-life experiences, open reflections, inspiration, and the bravery to just do it seem essential elements. In this sense, becoming an outdoor teacher, embracing the new world of green schoolyards, is not a one-dimensional process. Just as green schoolyards ideally are multi-dimensional, designed to foster hands-on, child-initiated learning experiences, so is the process of teachers becoming outdoor teachers also a real-life, hands-on process, which can lead to meaningful new teaching experiences. Just as greening schoolyards are supposed to invite children to be engaged with all their senses, to afford abundant opportunities to engage in exploratory, meaningful play experiences, so are teachers becoming an outdoor teacher confronted with the situation to discover the affordances of green schoolyards and develop a teaching attitude which facilitates and deepens learning situations for children.

Strengths and limitations

This thesis combines empirical evidence from direct observations amongst children and self-report measures of children, parents, and teachers to provide insight into the rationale for greening schoolyards and fosters its embedding in a school's practice. A multi-method design was employed, combining the strengths of both qualitative and quantitative methodologies. At international conferences, an often-heard comment after presenting research outcomes from, in

particular, chapter two was “you employed methods that we mostly refer to in our discussions as directions for future research”. I believe that this comment acknowledges the strength of the prospective intervention study set up to investigate the impact of greening schoolyards for children’s well-being and play behavior. It addressed many of the shortcomings of previous research on greening schoolyards by employing a design with pre- and post-measures and matched control groups. Besides, it combined self-report measurements with objective tests and coded video-observations of all children in the schoolyard. Furthermore, the collaborative action to inspire outdoor learning activities went beyond observational and survey data and provided knowledge that is rooted in teachers’ hands-on experiences. However, the research is not without limitations.

First, in chapter 2, it was not possible to randomly assign schools to intervention or control conditions. In a similar vein, in chapters 3, 4 and 5, self-selection of schools that made a conscious decision to re-design their schoolyard and/or to realize outdoor learning in the green schoolyard also poses a threat to the external validity of the findings. However, in chapters 2 and 4, green and paved schools were carefully matched on aspects such as socioeconomic status and level of urbanization. Further, random assignment of greening would seem inappropriate, because greening schoolyards requires long-term investments of teachers and parents (Maas et al., 2014). Future studies could attempt to include control schools that intend to re-design their schoolyard without the use of natural features.

Second, the selection procedure did not allow experimental control over the designs of the greening. As proposed throughout this thesis and discussion, it is plausible that non-optimal designs influence the outcomes, possibly leading to an underestimation of the potential of green schoolyards. Although this was outside the scope of the present thesis, future studies could systematically vary the inclusion of specific green schoolyard designs to shed more light on the ideal green design.

Third, all chapters include schools from moderate-to-high urbanized areas. The question remains whether our results can be generalized to children living in more rural, green areas. The ambition of a province in The Netherlands to green every primary school opens up the opportunity to study the impact of greening schoolyards while controlling for the level of urbanization. In addition, these ambitions allow opportunities to study the generalizability or differential impact of greening for children stemming from different socioeconomic backgrounds.

Fourth, data collection in chapters 2 and 3 was limited to one day a year at each school over three consecutive years. This could have led to random errors, such as the coincidence of time, weather conditions, or novelty effects. However, data collection on each school each year was scheduled in approximately the same period, special occasions were avoided, and researchers followed a strict protocol. Future research could expand the current approach by including multiple days of data collection. However, it was already challenging to find schools that were willing to invest time in the project and open their doors for one day a year. Another possibility would be to select one aspect, for instance, social well-being, and collect data for a more extended period on this single outcome measure. Such an approach is less invasive in a schools' daily practice and could ease the inclusion of schools willing to participate.

Fifth, in chapter 2, a between-subjects design was employed, which allowed for the elimination of noise in the data related to children's maturation and unrelated events occurring between measurements. However, to explore the impact of greening schoolyards on children's individual development over time, a within-subjects design would be more suitable. Furthermore, the chosen measures reflect on several domains of children's well-being, future research could include more rigorous measures on, for instance, children's academic achievement to draw more profound conclusions regarding the impact of greening on children's development.

Sixth, in chapter 3, children's play and non-play behaviors were coded with the Play Observation Scale. This scale also provides a coding scheme to observe the social play of children. Such codings were not included in the current research due to limited resources. Future research could focus on the impact of greening schoolyards on children's social play during recess, as the findings in chapters 2 and 4 indicate some promising, but also mixed results regarding children's social well-being. However, future researchers should bear in mind that our video material was not suited to code children's social play accurately, it would have been, in particular, challenging to distinguish between single and parallel play. More close up camera angles and preferably the addition of recording children's speech would be advisable. Also, extending the method using GPS tracking could provide a more in-depth insight into children's (social) play behavior (Lachowycz, Jones, Page, Wheeler, & Cooper, 2012).

Seventh, this thesis was unable to detect an impact of greening schoolyards on children's emotional well-being. As described in chapter 2, this could be due to a lack of emotional problems amongst children or the need to use a more sensitive methodology to explore the concept of emotional well-being.

Finally, chapter 5 addressed the teachers from the perspective on how they can realize outdoor learning in the green schoolyard. A consequence of this approach is that this thesis did not assess teachers' opinions regarding the impact of greening schoolyards on children's well-being and play behavior, as studied in chapters 2, 3, and 4. However, teachers' experiences with outdoor learning do provide valuable insights into the opportunities of green schoolyards for fostering children's well-being and development through outdoor learning. Future research could extend the approach and gain further insight into measuring the impact of greening schoolyards and in specific outdoor learning activities in green schoolyards on teachers' perceptions of children's well-being and academic development. These insights could be placed

along with the experiences of children and parents to create a complete image of users' views and opportunities of a green schoolyard.

Implications & future research

While the trend of greening schoolyards is gaining momentum across the globe, primary schools in The Netherlands can count on the support of different organizations and institutes in the process of greening their schoolyard. There are, for instance, funding possibilities available to green schoolyards, often accompanied with competitions for the best designs and possible landscape architects. The findings in this thesis strengthen empirical support for these initiatives and can inspire schools to develop fruitful collaborations with parents and realize green schoolyards as outdoor learning environments. Nevertheless, the findings also warrant primary schools and organizations not to be 'trapped in the beauty of the design' and adopt a critical and open approach towards developing and utilizing green schoolyards to their potential. They, for instance, could become more aware of theories explaining the benefits of nature contact for children and design schoolyards with insights derived from affordance theory and loose parts theory.

Suggestions for future research center around three themes: (1) Stimulating theory-driven and evidence-based designs of green schoolyards; (2) The impact of greening on emotional well-being; (3) Successful implementation of green schoolyards in a schools' organization and educational practice.

The first theme originates from the question raised by this study to which extent the designs of the schoolyards were rigorous enough to fully replicate the benefits of interacting with nature for children and foster their well-being and development. In this light, the findings presented in this thesis are promising, but also suggest a challenge to enhance the design of green schoolyards to optimize their potential. Future research could investigate aspects of an

optimal green schoolyard by developing a tool based on insights from the Affordance Theory (Gibson, 1979) and the Loose Parts Theory (Nicholson, 1972) to indicate which type of greening allows children to emerge in meaningful nature contact, enriches their play activities and thereby fosters children's well-being and development. Concomitantly, systematically varying schoolyard designs of included primary schools, while also employing a longitudinal study to examine the impact of greening on children's well-being and development, can validate the tool and inspire the development of theories to understand further how interactions with nature influence children's well-being and development. Previously mentioned GPS-tracking and voice recordings of children's behavior could further enrich such an approach.

More broadly, primary schools and researchers could establish projects to co-design green schoolyards. In a co-design, researchers and primary schools together design, evaluate and re-design the green schoolyard in several research loops to maximize the potential of its design and implementation. Such a collaborative action methodology can simultaneously inspire the quality of green schoolyard design, foster its implementation in the schools' organization and curriculum, and strengthen the rationale for greening schoolyards both on a practical and theoretical level. Co-designing allows researchers to systematically vary the designs, observe direct links between schoolyard design and its impact on children's well-being and development, and the findings can be directly implemented in a schools' practice to improve and stimulate practice-informed theory and research-informed designs. Furthermore, this collaboration could open up resources to study the impact of greening schoolyards on children's academic achievement and ease access to cohorts of longitudinal datasets.

The second theme for future research derives from the observation that the employed subscale of the Strength and Difficulties Questionnaire (SDQ) used in chapter 2 only addressed the prevalence of emotional problems; it does not include more positive indicators of well-being. Teachers in chapter 5 did mention positive impacts of green schoolyards; for instance,

how outdoor learning can support children in developing self-confidence and independence. Parents in chapter 4 also mentioned emotional resilience as an advantage of green schoolyards. Expanding quantitative evaluation research with a broad conception of emotional well-being and development that includes both negative and positive indicators could provide a more complete image of the potential of green schoolyards. Furthermore, future studies could also include other aspects besides coping with emotional problems - for instance, emotional resilience, self-confidence, and social competence.

Using this broad conception of well-being, future researchers may also explore the benefits of outdoor learning in the green schoolyard for children. To this end, researchers could replicate the participatory approach in chapter 5 and extend it with measurements of children's well-being, observations of the actions of teachers and indicators of children's development and academic achievement. Ideally, researchers could set up a project that allows a comparison between indoor and outdoor learning activities for an extended period. However, such an approach should be carefully constructed to respect the unique qualities of both classroom and nature-based learning.

A third theme for future research relates to gaining a better understanding of different strategies to stimulate parental involvement after greening and to motivate teachers to adopt outdoor learning. For example, future research could examine the effectiveness of informing parents on the benefits of green versus sharing knowledge between parents with and without experience with green schoolyards, and possible other strategies such as participation of parents in activities in the green schoolyard. In a similar vein, future research could examine the effectiveness of different strategies to motivate and support teachers in outdoor learning (e.g., 'just go for it' versus more guided training programs).

Employing a broader, more long-term perspective, future research can further examine how greening a schoolyard affect a schools' organization, vision on learning, and the

professional needs of teachers. Vice versa, studies can explore how different types of visions and organization of a school can stimulate a successful implementation of the green schoolyard as an outdoor learning environment. These insights can, amongst others, be implemented in teacher educations to prepare new teachers for a future in which green schoolyards are an evident aspect of a schools' educational practice.

Closing remark

From the beginning of my Ph.D., a quote in my Human Development textbook (Papalia, Olds, & Feldman, 2007) caught my interest, and I stuck it to my computer screen on a post-it for the first few years. It says: "*What we must remember above all in the education of our children is that their love of life should never weaken*" (cf. Natalia Ginzburg, *The Little Virtues*, 1985). The most important aspect of the research presented in this thesis is the lives of children. It is (or should be) for the children's sake that schools green their schoolyards, and it should be in the children's interest to utilize these green schoolyards to their potential.

The findings from this thesis provide support for the rationale of greening schoolyards for the well-being of children. Besides, they advocate practical implications to integrate green schoolyards in the schools' organization and curriculum. The thesis fosters a positive attitude but also warrants a critical attitude towards designing green schoolyards that resemble a nature experience that affords every individual child with experiences it needs to prosper and grow. Continued efforts are needed to unravel further the mechanisms that explain the impact of greening schoolyards on children's lives and development, and explore collaboration between research-and practice-informed green schoolyard designs.

Appendices

Summary

References

Acknowledgments

Curriculum Vitae

Summary

A growing number of primary schools across the globe have taken the initiative to re-design their schoolyard with natural features such as trees, flowers, sand, water, grass hills, and bushes to create a more attractive, so-called, 'green schoolyard'. The emergence of greening schoolyards is a response to a growing concern regarding children's loss of access to nature and fits within a broader context of environmental awareness and urban sustainability and health (Danks, 2010). In the past few decades, the number of studies indicating multiple benefits of greening schoolyards for children's physical, cognitive and social-emotional well-being and development has risen (Chawla & Nasar, 2015; Dadvand et al., 2019). Furthermore, green schoolyards hold promise to afford a rich play experience, where children show more diverse forms of play, and that is sensitive to the needs of both boys and girls (Dyment & Bell, 2007a; Lucas & Dyment, 2010; Samborski, 2010). Besides, green schoolyards thought to provide an enriching outdoor learning environment. Not only to learn about nature, but also for lessons in, for instance, mathematics, language, or arts (Ballantyne & Packer, 2009; Barfod et al., 2016).

Assumptions and expectations regarding benefits of green schoolyards for children's well-being and behavior are rooted in a multidimensional theoretical framework of cognitive, affective, and behavioral explanations. Within this framework, Attention Restoration Theory (ART; Kaplan, 1995), and Stress Recovery Theory (SRT; Ulrich, 1983) posit that an unthreatening natural environment elicits a soft fascination and immediate positive response that fosters attention restoration and relaxation which could explain a positive impact of greening schoolyards on children's cognitive and emotional well-being. Furthermore, the biophilia hypothesis (Kellert & Wilson, 1995) states that all human beings have a need to affiliate and connect with life and life-like forms. Playing on a green schoolyard can fulfill this need, and thereby foster a sense of connectedness to nature. This connectedness stimulates

increased feelings of psychological well-being and has also been linked to more pro-social behavior in children (Collado et al., 2013).

According to another line theorizing, greening creates an enriched play situation that holds abundant affordances, opportunities for play that speak upon a child's abilities, needs and interests (Affordance Theory, Gibson, 1979), and in which features are less set compared to ready-to-use (built) play equipment (Loose Parts Theory, Nicholson, 1972). Compared to a paved schoolyard, a green schoolyard is expected to be more multi-dimensional and responsive to children's individual needs, abilities, and interests. Children are invited to engage in open and flexible play experiences that stimulate more constructive, imaginative, and exploratory play. These enriched play experiences stimulate a more varied and inclusive play experience, that fosters, for instance, children's physical activity, social interaction, and skill mastering (Chawla et al., 2014; Dymont & Bell, 2007a).

An increasing body of empirical evidence supports these theoretical explanations. However, the available evidence is still limited and, in some cases, mixed or inconclusive. Moreover, most studies suffer from limitations such as lack of pre-measurements or control groups. The present thesis aimed to strengthen the empirical base for greening schoolyards with insights that afford the rationale for greening and the development of practical knowledge to support the optimal implementation of greening to promote children's well-being. It examined (a) the impact of greening schoolyards on children's appreciation, and physical, cognitive and social-emotional well-being, (b) the impact of greening schoolyards on children's play behavior during recess, (c) parental opinions on green schoolyards, and (d) how teachers can incorporate the green schoolyard as an outdoor learning environment.

Chapter 2 and chapter 3 present the results of a longitudinal prospective intervention study with a two-year follow-up amongst schoolchildren aged 7 to 11, conducted to investigate the impact of greening schoolyards. Data were collected amongst nine elementary schools in

moderate-to-high-urbanized areas in The Netherlands with approximately 700 children at each measurement. At baseline, all nine schools were paved. Five schools greened their schoolyard between baseline and first follow-up. During recess, objective measurements included accelero-based measurements of physical activity and video observations were made and afterward coded using the cognitive play categories and non-play categories of the Play Observation Scale (Rubin, 2001). In the classroom, objective measurements included attentional tests (Digit Letter Substitution Test, Natu & Argwal, 1995 ; Sky Search Task, Manly et al., 2001) and a social orientation test (Social Orientation Choice Card, Knight, 1981). Self-report questionnaires in the classroom included children's appreciation of the schoolyard (naturalness, likability, attractiveness, and perceived restoration), and their social- and emotional well-being (Strength and Difficulties Questionnaire, van Widenfelt, Goedhart, Treffers & Goodman, 2003 ; Social Support, RIVM, 2005 ; Pediatric Quality of Life Inventory, Varni, Seid & Kurtin, 2001).

Chapter 2 reports the findings of multilevel data analyses supporting the expectation that greening has a positive impact on children's appreciation of the schoolyard, their attentional restoration after recess, and social well-being. Furthermore, the results indicate that greening stimulates the physical activity of girls in particular. No impact was found on emotional well-being. These findings provide some support for the rationale of greening schoolyards and may guide further development of schoolyards that foster the well-being of schoolchildren.

Chapter 3 presents the findings of video-observations showing an increase in observed play, as compared to non-play, behavior, after greening. Furthermore, there was an observed increase in games-with-rules, a small increase in constructive and exploratory play behavior, and a decrease in passive non-play behaviors. This impact of greening was stronger for girls compared to boys. These findings strengthen the empirical basis for greening schoolyards as a means to create inclusive playscapes that serve the needs of all children. However, they also shed more critical light on the designs of the green schoolyards, and promote further research

to optimize these designs to create environments that afford children to engage in more creative and exploratory play behaviors.

Although there are indications that parental support is an essential factor in the successful implementation of green schoolyards (Redman, 2013), we know little about how parents view the green schoolyard and how they wish to be involved. To this end, chapter 4 described the findings from two surveys covering the perspective of parents and their willingness to become involved. A total of 402 parents of children in schools with green and paved schoolyards were asked about their appreciation of the schoolyard, children's behavior in the schoolyard, (dis)advantages of a green schoolyard, and willingness to become involved. Findings showed that parents from schools with a green, compared to a paved, schoolyard showed higher appreciation of the schoolyard and more often reported that the schoolyard supports varied play and other behaviors. Parents generally saw more advantages than disadvantages of a green schoolyard, and many parents indicated that disadvantages, such as children coming home dirty, are not very important to them. Parents wanted to be involved, but their time to help is limited. They are most interested in being involved in the design and help with activities in the schoolyard. They are less willing to help with maintenance.

Outdoor learning remains mostly unrealized in current educational practices. Previous studies identified several barriers that hinder teachers from teaching outdoors (Dyment, 2005; Maynard & Waters, 2007). However, thus far, no study has actively addressed how teachers can overcome barriers and integrate outdoor learning in their curriculum. Chapter 5 describes the experiences of teachers while they took part in a collaborative action research project aimed to integrate the green schoolyard in their curriculum as a learning environment. In this project, teachers of five primary schools in The Netherlands were followed during two consecutive years, and across schools, a total of 20 meetings were organized in which 75 teachers participated. Results revealed four broad themes encompassing barriers and solutions teachers

encountered during hands-on experiences with outdoor learning in their daily practice. Teachers feel hindered by outdoor learning having no formal status in their current educational practice, experience barriers related to a lack of confidence in their outdoor teaching expertise, find it difficult to get started, and experience barriers related to physical constraints. Teachers, professionals, and researchers together found solutions to overcome each specific barrier. These solutions are translated into general recommendations: just do it, get educated and inspired, engage in real-life experiences, get an outdoor pedagogical mindset, and follow a tailored process. The findings can be used by primary schools and other institutions to develop interventions that support teachers to integrate the green schoolyard as a learning environment further.

In general, the findings presented in this thesis speak to a positive impact of greening schoolyards on children's appreciation of the schoolyard, attention restoration, social well-being, and play behavior. Moreover, it is shown that parents tend to have a favorable view of greening, and teachers' experiences revealed four themes encompassing barriers and solutions to develop outdoor learning on the green schoolyard. Across the chapters, the findings are summarized into five themes: (1) Trapped in the beauty of the design. This theme described the robust findings in chapters 2, 3, and 4 that greening leads to a higher appreciation of the schoolyard and more varied and inclusive play behavior. However, it also highlights that both outcome measurements leave room for improvement and discusses how green schoolyard designs could be optimized in future research. (2) Go girls! This theme captures indications in chapters 2, 3, and 4 that greening stimulates in particular girls to become more physically active and engaged in play behavior during recess. Also, there are indications that greening stimulates in particular girls to become more physically active and engaged in play behavior during recess. (3) The curious case of children's attention span. This theme accumulates findings in chapters 2 and 4, which show support for a positive impact of greening on attention restoration. These

findings are aggregated with experiences from teachers in chapter 5 that, during outdoor learning, children's attention can be drawn towards (or distracted by) nature-based features in the environment. (4) The impact of greening on children's social well-being. This theme merges the mixed findings of chapters 2 and 4 regarding an impact of greening on children's social well-being. (5) Not solely a green schoolyard, but a green school. This theme encompasses practical implications distilled from chapters 4 and 5 to ongoingly invest in a green schoolyard and maximize its potential as an outdoor learning environment.

Altogether, findings strengthen the rationale for greening schoolyards and provide practical implications to support the optimal implementation of greening to promote children's well-being. Implications and suggestions for future research center around three themes: (1) Stimulating theory-driven and evidence-based designs of green schoolyards. (2) The impact of greening and outdoor learning on children's emotional well-being, and (3) Successful implementation of green schoolyards in a schools' organization and educational practice. Regarding the first theme, future research could replicate and extend the longitudinal intervention study to investigate the optimal aspects for enhancing the designs of green schoolyards and continue to unravel the mechanisms that explain the impact of greening on children's well-being and development. Regarding the second theme, future studies on benefits of greening could employ more encompassing measures of well-being that capture not only emotional problems but also positive indicators. This broad approach could also be used to examine benefits of outdoor learning for children. Regarding the third theme, future studies may examine the effectiveness of different strategies for involving parents and motivating teachers to implement outdoor learning in the green schoolyard. More broadly, future research may examine how greening a schoolyard affects a schools' organization, vision on learning, and the professional needs of teachers. Vice versa, studies can explore whether and how adopting the vision and organization of a school stimulates a successful implementation of the

green schoolyard as an outdoor learning environment. Across the three themes, close collaborations between designers, teachers, and researchers could bolster the evidence base for greening schoolyards and understanding of the benefits of experiences in nature for children's lives.

To conclude, this thesis fosters a positive but also critical attitude towards designing green schoolyards that resemble a nature experience that affords every individual child with experiences it needs to prosper and grow. Continued efforts are needed to unravel further the mechanisms that explain the impact of greening schoolyards on children's lives and development, and explore collaboration between research- and practice-informed green schoolyard designs.

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Curriculum Vitae



Janke van Dijk-Wesseliuss was born on February 14th 1987 in Smalingerland, the Netherlands. She obtained her Undergraduate's and Master's degree in Psychology at the University of Groningen. During her Master's she became interested in the study of Environmental Psychology. She received her PhD training at the Vrije Universiteit Amsterdam, under supervision of Dr. J. Maas and Prof.dr. M. van Vugt, and Prof.dr. A.E. van den Berg (University of Groningen).

Research interest

During her Master's she gained interest in the development and implementation of initiatives that promote a healthy environment and lifestyle. A personal encounter with the healing effects of nature, inspired her to further understand how green initiatives can promote human health and well-being. Together with Prof.dr A.E van den Berg during her Master's she took a first step in this journey in studying how mindfulness and nature can reinforce each other in promoting recovery from emotional distress in a virtual reality setting. Her PhD was a second step in this journey. In her work as an Impact Consultant and Data Analyst for Sinzer (powered by Grant Thornton) she continues her ambition to further promote healthy and sustainable environments.

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Invited Revisions

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