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The urban landscape as affordance for adolescents' everyday physical activity

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ABSTRACT

This study explores factors in the physical outdoor environment of the urban landscape that promote or hinder adolescents' physical activity (PA). The analysis was inspired by Gibson's affordance concept. The study combines actual use with potential affordances in neighbourhoods to generate special classes of actualised affordances. Two Norwegian school districts and their local neighbourhoods in different landscapes were selected as case areas. The patterns of adolescents' everyday leisure-time activity were recorded using 'children's tracks' methodology. Landscape characterisation connected the activity patterns to the physical structure of the landscape. Our study suggests that urban landscape structure is associated with PA patterns and adolescents' choice of activity types. Our results confirm previous studies as regards the importance of neighbourhood design and facilities for PA in promoting such activity.

KEY WORDS

Physical activity; school neighbourhood; landscape characterisation; urban landscape; affordance; adolescence

Introduction

The general level of physical activity (PA) among adolescents in Norway is too low. Only 43.2% of 15-year-old girls and 58.1% of boys (The Norwegian Directorate of Health, 2012) fulfil the recommended 60 minutes of moderate to vigorous PA per day (WHO, 2007). In addition, activity decreases dramatically from childhood to adolescence: 69.8% of 9-year-old girls and 86.2% of boys of the same age reach the recommended level of daily activity. Given this disparity, investigating adolescents' PA patterns is an important research objective.

PA is an important health promotion factor. It is essential for energy balance and weight control, and it reduces the risk of coronary heart disease and stroke, type 2 diabetes, colon cancer and breast cancer among women (WHO, 2008). Urban planning can help to stimulate PA by providing accessible areas where such activity can take place (Edwards & Tsouros, 2006). Freely and easily accessible areas for PA should be available for everybody in the neighbourhood, including those with the lowest socio-economic status, who are among the most inactive groups (The Ministry of Health and Care Services, 2005).

Space is needed to provide arenas for PA. However, many European urban planning policies promote compact cities. To enhance the liveability of compact cities, it is crucial to understand the inhabitants' needs and use of the urban landscape. This study aims to explore whether and how neighbourhood-scale physical environmental factors influence adolescents' everyday leisure-time activities.

The knowledge gap and research questions

PA behaviour is a compound phenomenon with numerous influencing factors, and previous research has used many different approaches to explore the topic. The relationship between PA and the physical environment is complex and often indirect.

Urban form is one of the most studied topics, mainly concentrating on the accessibility of parks or leisure facilities, distances to destinations and neighbourhood characteristics. The analyses are usually quantitative and look at distances, size or spatial patterns.

One of the most investigated themes in PA research, which is closely related to urban form, is *transport*, or, more specifically, the walkability/bikeability and connectivity of the road network (Frank, Schmid, Sallis, Chapman, & Saelens, 2005; Kerr, Frank, Sallis, & Chapman, 2007; McMillan, 2007). The structure of pedestrian and cycle networks is considered to have a significant influence on their use (Saelens, Sallis, & Frank, 2003; Tucker et al., 2009).

The *outdoor environment's content and facilities* for promoting PA are also central research themes. In general, functional diversity is considered to improve walking activity (Boer, Zheng, Overton, Ridgeway, & Cohen, 2007). In most cases, accessible leisure/sports facilities (Gordon-Larsen, Nelson, Page, & Popkin, 2006; Hume, Salmon, & Ball, 2005; Limstrand, 2008; Norman et al., 2006) or parks (Babey, Hastert, Yu, & Brown, 2008; Cohen et al., 2007) are associated with increased PA and walking/biking (Grow et al., 2008), or with moderate to vigorous PA in adolescents (Boone-Heinonen, Popkin, Song, & Gordon-Larsen, 2010). On the other hand, Ferreira et al. (2007) found no association between the accessibility of PA equipment and PA.

Access to *nature* is an important part of this research field (Gardsjord, Tveit, & Nordh, 2013). The role of the natural environment appears to be significant in promoting activity in small children (Fjørtoft, 2001; Fjørtoft & Sageie, 2000). Travlou also concluded in her review (Travlou, 2006) that a wild adventure space has a positive influence on young people's physical development and emotional and mental health. Preference for natural settings varies with children's age in a complex manner, however (Korpela, Kytta, & Hartig, 2002).

Another important influencing factor is *safety*. In general, perceived safety appears to affect PA behaviour (Grow et al., 2008; Limstrand, 2008) to a greater extent than objectively measured safety. However, Ferreira et al. (2007) found no association between perceived neighbourhood safety and adolescents' PA. Traffic safety is also associated with adolescents' PA behaviour (Grow et al., 2008), although the results are not consistent (Haikkola, Pacilli, Horelli, & Prezza, 2007).

An overall assessment of the status of knowledge about the outdoor environment and PA reveals a research field with a fragmented view of the landscape. Studies are often attribute-oriented (e.g. distance to activity areas, local services and area size) and mainly quantitative. They often lack detailed landscape information, although the research community has recognised the importance of this field (Davison & Lawson, 2006; Wells, Ashdown, Davies, Cowett, & Yang, 2007). By studying PA behaviour based on a more holistic landscape-scale approach, it may be possible to understand what motivates people to move in and through the landscape.

With this overall objective, the main question this study aims to answer is as follows:

Are there characteristics of the urban landscape that promote or hinder certain kinds of use and PA amongst adolescents?

This can be broken down into the following two sub-questions:

- How do activities vary in different landscapes?
- How do differences in facilities for PA influence PA patterns?

In our study, the term *PA* equates to everyday outdoor activities, e.g. getting to and from school, and participation in outdoor sports activities, play and recreation during leisure time.

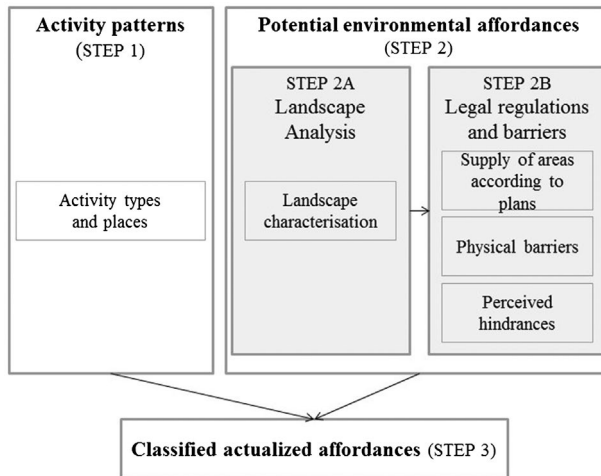


Figure 1. Theoretical approach based on Gibson's affordance theory (Gibson, 1977; Heft, 1989) and analysis methods in the research project.

Theoretical approach

The affordances concept (Gibson, 1977) interprets the link between humans and the environment as inherently relational. Affordances are a '... combination of physical properties of the environment that is uniquely suited to a given animal—to his nutritive system or his action system or his locomotor system' (Gibson, 1977, p. 79). Heft (2010, p. 28) states that 'Because affordances are action-related properties of environments, they are particularly well suited for considering the implications of environmental design for health promotion and "active living"'. The concept has already proved useful for identifying environmental factors that influence children's and adolescents' use of their urban surroundings (Clark & Uzzell, 2002; Heft, 2003; Kyttä, 2004).

We believe that Gibson's approach fits well with our understanding of landscape as a comprehensive arena. He claims that 'the invariant combination of properties is "meaningful" whereas any single property is not' (Gibson, 1977, p. 68), which shifts the focus from the attribute-oriented aspect to the complex landscape level.

Methodology

Case selection

The research project focused on how different urban landscapes influenced PA behaviour. A comparative case study design was used for this purpose. Two schools, Begby and Gudeberg, and their neighbourhoods were selected in different landscapes in Fredrikstad, Southern Norway, which is an urban area (by Norwegian standards). The municipality has approximately 72 000 inhabitants. The settlement is scattered on both sides of the Glomma River. The selected school districts are located in two different neighbourhood areas on the eastern side of the river. Begby is situated in a hilly, natural landscape dominated by indigenous vegetation and has an organic road structure, while Gudeberg is in a more open, flat area with mainly cultivated vegetation and a grid road system.

All 9th and 10th grade classes in the schools, a total of 121 pupils (14-year-olds), were invited to participate in the project. Participation was voluntary and the number of participants differed between the data collection stages. In the 'children's tracks' exercise, 57 children (16 from Gudeberg and 41 from Begby) contributed to paper mapping, while 88 participated in the digital mapping (43 from Gudeberg and 45 from Begby).

Analysing affordances

Figure 1 provides an overview of the theoretical approach and analysis methods applied in the research project.

We studied actualised affordances on the basis of PA behaviour, i.e. movement patterns (Figure 1 STEP 1). Through their everyday activities, the participants expressed their perception of the neighbourhood outdoor environment. This is the landscape 'as perceived by people' (Council of Europe, 2000, p. 3).

The second parameter comprises the potential affordances in the landscape (Figure 1 STEP 2A). They are everything that the landscape has to offer in terms of opportunities for activity and general outdoor use. Landscape analysis is the expert's interpretation of landscape; it explores the role of combinations of different *layouts*, or, more accurately, *shapes of surfaces* (Gibson, 1986, pp. 28–29), i.e. spatial patterns, and specifies the *potential environmental affordances*, including negative affordances, for PA. We used a morphological approach to identify unique landscape character area types, combining information about landform, vegetation cover, building and road layout. The aim was to show the variation in spatial patterns.

As the landscape contains an infinite number of potential affordances for PA, the focus had to be narrowed down to the *affordances utilised*. In Heft's terminology (1989), these are called *actualised affordances* (Figure 1 STEP 3).

STEP 1. Identifying activity patterns

We collected self-reported data relating to the adolescents' general use of the neighbourhood areas using a method called 'children's tracks'¹ (Almhjell & Ridderstrøm, 2003). The children's tracks exercise took place in two phases. The first phase consisted of paper mapping in the field. This was followed up by a second, digital phase, where the pupils drew their movement patterns as digital maps and described these activities. The following information was collected:

- The roads and tracks they used and perceived possible dangers, such as traffic hazards, lack of lighting and 'creepy' people.
- Areas they used. In the digital phase, they also registered the estimated number of users, activity types and seasonal differences.
- Places the pupils want to improve or consider dangerous.

The pupils registered similar information in the manual and digital phases, but descriptive information was only provided in the digital mapping (Aradi, 2010). Due to the digitalisation method, the paper maps provided more precise spatial information. The paper maps were therefore also digitalised and combined in the analysis with the adolescents' own digital maps.

The preparation included self-guided tours and paper mapping that was conducted as part of their schooling. This data collection phase took place in October to November 2008. In Gudeberg, the students used the PA lesson for the outdoor mapping tours, while in Begby, they did it as homework. The weather conditions were generally good, with the temperature around 10 °C. Altogether, a total of 57 paper maps were compiled.

The digital phase took place in the schools in November 2008 (Begby) and in January 2009 (Gudeberg) under the guidance of researchers from the project group. The pupils digitised their activities and completed descriptive information in an online mapping programme (Kartiskolen, 2010), individually (Begby), or in small groups of two to three pupils (Gudeberg). In total, 88 pupils registered 248 road segments, 69 areas and 93 places. Based on the described and mapped activities, we identified the pupils' movement routes and categorised the pupils' activities into 13 types (See Figure 3 under Results). These types were further divided into organised and non-organised activities:

- *organised activities*: paintball, football, other ballgames, riding, rowing.
- *non-organised activities*: other ballgames, skateboarding, biking, using play equipment, meeting

Table 1. Landscape character area types.

ID	Landscape character area type
1	Small detached houses in an irregular layout in half-open cultivated areas in hilly terrain
2	Small detached houses in an irregular layout in half-open cultivated areas in plains
3	Orderly small and medium detached houses in half-open cultivated areas in plains
4	Orderly small and medium detached houses in half-open cultivated areas in hilly terrain
5	Urban perimeter blocks in grey/half-open cultivated areas in artificial terrain
6	Urban perimeter blocks in half-open/grey cultivated areas in plains
7	Urban perimeter blocks in half-open/grey cultivated areas in hilly terrain
8	Apartment blocks in half-open/grey cultivated areas in plains
9	Apartment blocks in half-open/grey cultivated areas in hilly terrain
10	Row and terraced houses in half-open cultivated areas in hilly terrain
11	Row and terraced houses in half-open cultivated areas in plains
12	Large multi-family houses in half-open cultivated areas in hilly terrain
13	Large multi-family houses in half-open cultivated areas in plains
14	Scattered housing in half-open cultivated areas in hilly terrain
15	Scattered housing in half-open cultivated areas in plains
16	Scattered housing in grey cultivated areas in plains
17	Large detached buildings in grey cultivated areas in plains
18	Large detached buildings in grey cultivated areas in hilly terrain
19	Large detached buildings in grey/half-open cultivated areas in artificial terrain
20	Large detached buildings or scattered housing in <40% tree cover cultivated areas in plains
21	Large detached buildings in <40% tree cover cultivated areas in hilly terrain
22	Large detached buildings in half-open cultivated areas in hilly terrain
23	Large detached buildings in half-open cultivated areas in plains
24	Grey cultivated areas in hilly terrain
25	Grey cultivated areas in plains
26	Grey cultivated areas on water surfaces
27	Various nature areas in hilly terrain
28	Various nature areas in plains
29	Open cultivated areas in hilly terrain
30	Open cultivated areas in plains
31	Open cultivated areas in artificial terrain
32	<40% tree cover cultivated areas in hilly terrain & riverside valley
33	<40% tree covered areas in plains
34	<40% tree covered areas in artificial terrain
35	Half-open cultivated areas in hilly terrain
36	Half-open cultivated areas in plains and artificial terrain
37	Water surfaces

friends/hanging around (in built-up areas), meeting friends/hanging around (in nature areas), shopping, skiing, ice skating.

The output from the activity type and movement routes analysis was one of the essential inputs for the actualised affordances (Figure 1 STEP 3).

STEP 2. Identifying potential environmental affordances in the urban landscape

Our initial hypothesis was that areas with different landscape characteristics offer different opportunities for activities.

To characterise the landscape (Figure 1 STEP 2A), we included aspects of the physical environment that—based on the literature study and on our experiences from the data collection—seemed to be associated with adolescents' PA behaviour: terrain, built morphology, road structure and vegetation typology. The combination of these themes resulted in a landscape character area type map that covers the study area. This provided an overview of the differences in the neighbourhood and formed the physical framework for the actualised affordances. The analyses were conducted in ArcGIS®.

We delineated the study area by extending it to include all registered movement patterns. As a first step, we categorised the landscape into single themes (terrain, built morphology, road structure, vegetation typology). We generated landforms from a digital elevation model (Norge digitalt, 2010) and generalised them into three main terrain categories:

- (1) plains,
- (2) hilly terrain and
- (3) artificial landform around the historical fortress close to the river Glomma in Gudeberg.

The vegetation mapping was based on an existing vegetation typology map, scale 1:5000, prepared according to a method created by Thorén (2000). The map was updated using orthophotos. The typology had two main vegetation types: nature (N) and cultivated (K), and there were five subcategories in each type based on the openness of the vegetation cover: >40% tree cover areas (e.g. dense forests, parks with well-developed tree layer), <40% tree cover areas (e.g. parks with even distribution of shrubs and trees, but less than 40% tree cover), semi-open areas with scattered trees, open areas (e.g. pastures, grassy areas) and water surfaces (nature) or grey areas (with no vegetation).

In an urban environment, the terrain or vegetation cover alone does not provide adequate information about the landscape. In order to refine the categories in the built-up areas, we defined eight different building typologies:² small detached houses in an irregular layout, small and semi-detached houses in a uniform layout (maximum 2 households), urban perimeter blocks (densely built-up areas), apartment blocks (high-rise buildings), row houses and terraced houses, large multi-family houses, scattered housing and large detached buildings (such as sports halls, shopping centres and industrial buildings). We combined these categories with the terrain, vegetation information and the two road structure types: *organic and grid*.

After simplification, this synthesis resulted in 37 distinct landscape character areas (Table 1 and see Figure 3 under results). These landscape character areas show the unique characteristics of the physical landscape, i.e. the '*combination of properties*' (Gibson, 1977, p. 68).

In order to understand the context of the actualised affordances, we analysed possible limiting factors (Figure 1 STEP 2B): the delineation of areas for PA according to municipal plans, (hereinafter referred to as 'accessible areas'), and barriers (specified later). These accessible areas and barriers determine the physical arenas in which activities can be carried out. The analysis is based on:

- the municipal plan (Fredrikstad Municipality, 2010a), detailed zoning plan (Fredrikstad Municipality, 2010b),
- traffic information,
- self-reported fears from the children's tracks exercise.

We restricted the accessible areas to those areas in the municipal plans that were publicly accessible for activities (i.e. sports fields, sports halls, playgrounds, recreational areas, pedestrian and bicycle roads). By overlaying designated green areas, sports areas and special transportation areas with the landscape character area types and comparing the results with the activity patterns and levels, we gained an overview of the importance of these designated green areas in the adolescents' everyday activities.

Everyday movement patterns can either revolve around getting to school or organised activities, or they may be recreation-oriented without clear goals. In the first case, the shortest/fastest route has higher priority than other qualities of the destinations or possible routes. Such possible destinations for everyday use or recreation that the adolescents often use for different activities were selected from the plans, such as community and recreational buildings, schools, churches and public buildings. For activities without clear goals, the whole neighbourhood is a possible activity area, and other qualities of the environment might be more important than shortest/fastest route.

Given that areas with a better provision of designated green areas and sports areas and/or destinations may be more attractive for use, we calculated the overall area of these possible target areas in the landscape character area types.

Barriers in our study were safety-related issues: *Traffic information* (Norge digitalt, 2009) and the adolescents' own observations from the digital 'children's tracks', which showed where such barriers were present.

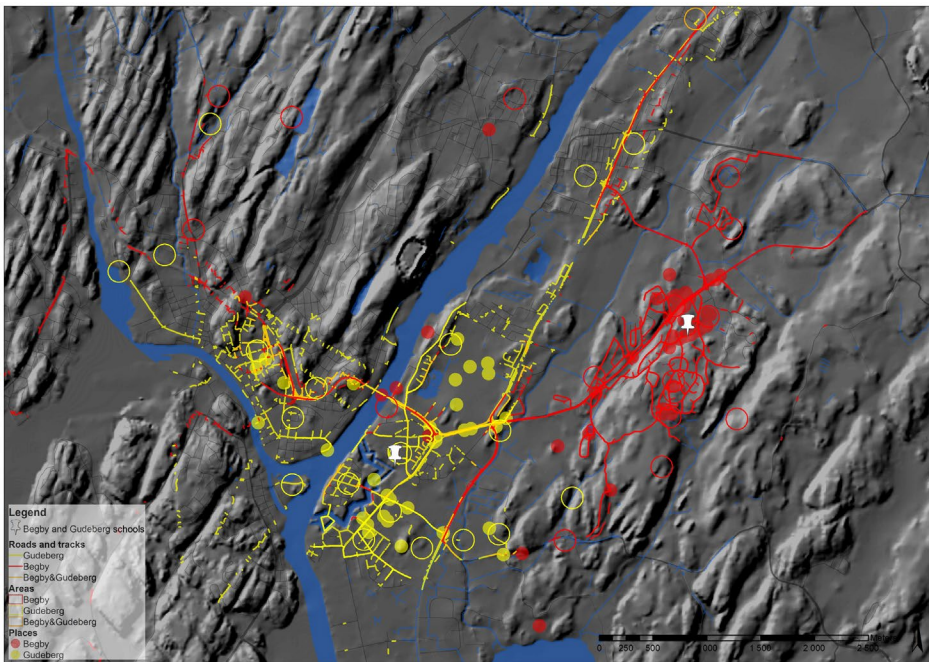


Figure 2. Registrations by schools.

STEP 3. Identifying actualised affordances

We explored the places in the landscape that were used by the pupils. For this purpose, we overlaid the landscape character area types with activity patterns. We aimed to find patterns in the landscape that corresponded to the PA behaviour. The analysis resulted in actualised affordances (Figure 1 STEP3).

First, we analysed the *activity patterns*. We used the categorised activity areas from the pupils' digital maps. The paper maps from the children's tracks exercise were used to analyse walking/biking activity patterns.

We also wanted to gain insight into how popular areas/routes were. This analysis was not straightforward. In the digital mapping, the participants estimated the number of users in the areas they registered, which means these numbers are not exact. We therefore categorised the number of users into four groups: one, few, some and many users.

Code of ethics

The children were selected in a voluntary manner in accordance with the Helsinki Declaration (WMA, 1964). Written informed consent was given by parents and children. All data collection and analysis was treated anonymously in accordance with ethical guidelines.

Results

The leisure-time activities (routes, areas, places) registered by pupils (Figure 2) showed a neighbourhood-oriented use. This meant an area of about 2–3 km around the schools. There was limited spatial overlapping between the activities around Begby and Gudeberg.

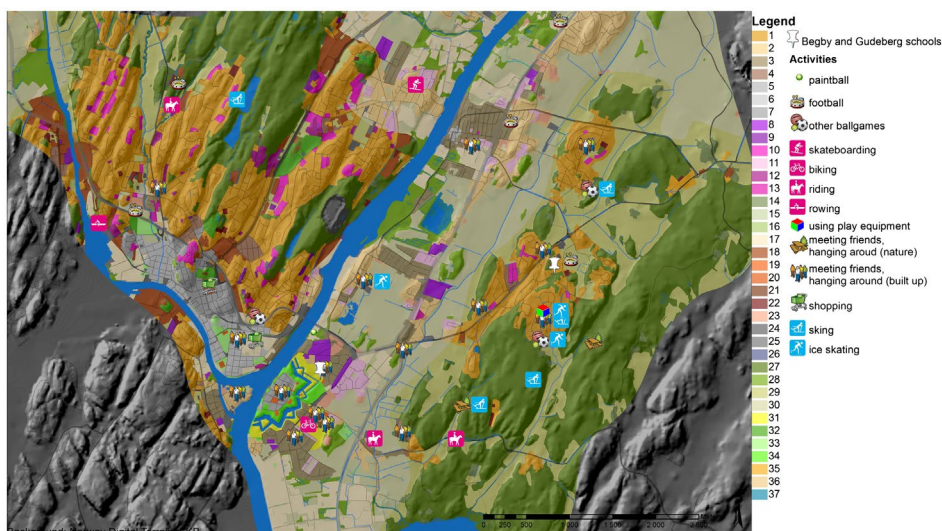


Figure 3. Activity types in the landscape character area types.

How do activities vary in different landscapes?

In order to answer the first sub-question, the activity patterns (Figure 1 STEP 1) were combined with the potential environmental affordances (Figure 1 STEP 2A).

Figure 3 and Table 2 provide an overview of how the thirteen activity types were distributed between the landscape character area types. The overall picture showed activity types in 27 of the 37 different landscape character areas.

The landscape character area type with the *most different activity types* (seven) was a residential area in hilly terrain with small family houses in an irregular layout (Figure 3, Table 2, ID1). Other area types with more than three different activities were mainly areas with special community and/or leisure-time activity destinations (ID17, 25, 27, 29, 30).

The *most preferred* areas, with many (ID36) or some (ID25, 29, 30, 31, 37) registered users, were in non-residential areas in varied terrains, in which open cultivated areas (e.g. grassy areas and sports fields) dominate. Not surprisingly, *the routes* with the most users in both neighbourhoods were the main collector roads.

There were ten landscape character area types where *no activities* were registered. The majority of these areas were in the western part of the study area (ID7, 9, 12, 13, 20, 21, 26, 32). Most of them were small residential areas of an unusual type, for example urban perimeter blocks or apartment blocks in hilly terrain or large multi-family houses, and the distance to them can explain the lack of use: the western part of the city was not extensively used. In the eastern part of the city, the unused area types included an industrial, agricultural/service area (ID16) and one multi-family housing area (ID11) of which there were few in this part of the city. Apartment blocks (ID8) were the unused area type of the largest size on the eastern side. One explanation for the lack of use of these two housing areas could be that their immediate neighbourhoods are mostly used by people living there. There may have been a lack of participants from these areas in this part of the study.³

How does the difference in PA facilities influence PA patterns?

The hypothesis used to analyse the provision of destinations for PA in municipal plans was that difference in PA facilities influences the activity pattern. In general, the neighbourhoods had good provision of green and recreational areas. The eastern part of the study area had more *agricultural-nature and*

Table 2. Activities, number of users and neighbourhood differences in the landscape character area types; user number categories in the activity type areas (child track): few: 2–41; some: 42–82; many: 83–122; aggregated user number categories in landscape character area types (child track): few: 2–52; some: 53–105; many: 106–155. B = Begby, G = Gudeberg.

ID	Activity types: number of users/neighbourhood/gender (child track)												
	Aggregated number of users (children's track)	Meeting friends	Horse-back riding	Shopping	Biking	Skiing	Ballgames	Rowing	Football	Playing	Paintball	Ice skating	Skate boarding
1	Few	Few/B;G	One/G	Few/G		Few/B	Few/B			Few/B		Few/B	
2	Few	Few/G		Few/G									
3	One	One/G											
4	One	One/G											
5	Few	Some/G											
6	Few	Few/G		Few/G									
7	—												
8	—												
9	—												
10	One	One/B											
11	One	One/G											
12	—												
13	—												
14	Few	Few/G	Few/B			Few/B;G							
15	Few	Few/G											
16	—												
17	Few	Few/G	One/G	Few/G				One/G			Few/B		
18	Few	Few/B		Few/G									
19	Few	Few/G											
20	—												
21	—												
22	Few	Few/B;G											
23	Few	Few/G											
24	Few												
25	Some	Some/	One/G				Few/G	One/G				Few/G	
26	—												
27	Few	Few/B;G	Few/B;G										
28	Few	Few/G			Few/G;B	Few/B;G	Few/B						
29	Some	Few/B;G	Few/B;G						Few/B				
30	Some	Few/G	One/G		Few/G	Few/B;G			Few/B				One/B
31	Some	Few/G			Few/G				Few/B;G				
32	—												
33	Few	Few/G											
34	Few	Some/G											
35	Few	Few/G											
36	Many	Many/G											
37	Few	Some/G			Few/G			1/G					

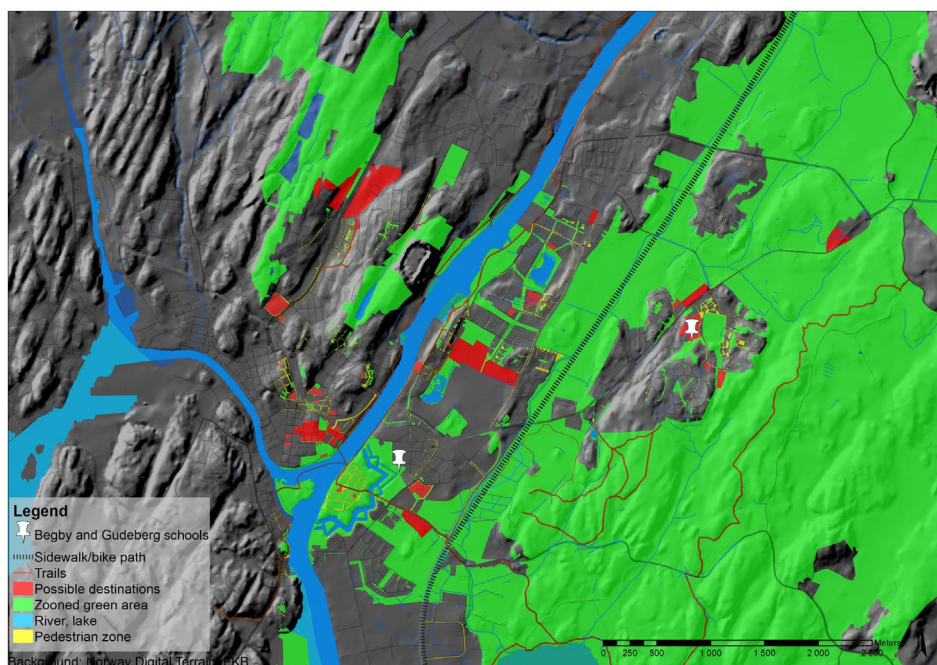


Figure 4. Zoned green areas (parks, playgrounds, sports facilities, recreational areas for outdoor life, agricultural- nature and recreation areas, protected nature and cultural heritage areas, church yards, green isolation belts of industrial areas, small boat harbours) and possible destinations (recreational buildings, educational institutes, community, administrative and public buildings, churches, gasoline stations) for PA in the neighbourhoods.

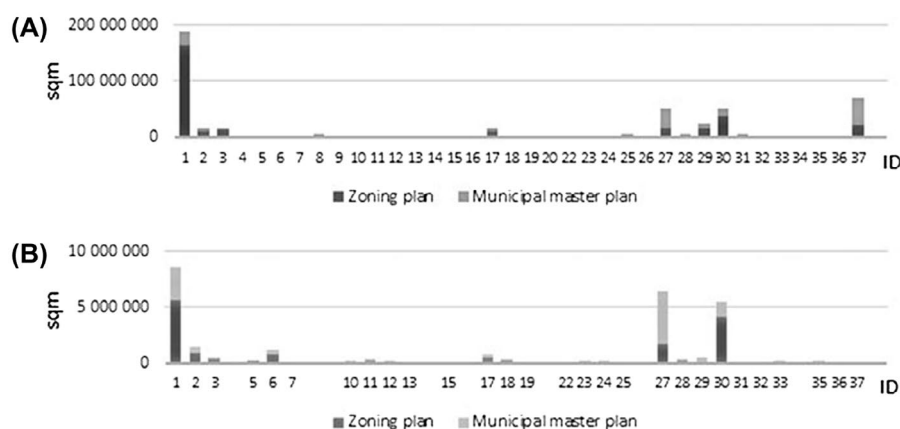


Figure 5. The size of designated green areas (A) and possible destinations (B) in the landscape character area types.

recreation areas (Figure 4). According to the plans, the number of possible destinations did not vary much between the two neighbourhoods. The part of the area shared by the two neighbourhoods, to the north of Gudeberg and to the west of Begby, had the best provision.

In this analysis, the publically accessible areas (Figure 1 STEP 2B) were combined with activity patterns (Figure 1 STEP 1). The result showed that non-residential landscape character area types with varied terrains (ID17, 27, 29, 30, 37) and bigger designated green areas (Figure 5(a)), and/or selected possible destinations from municipal plans (Figure 5(b)) played an important role in outdoor activities. Only one

of the residential area types, the small detached houses in an irregular layout in hilly terrain (ID1), was among the most used. Furthermore, there were also favoured landscape character area types where the size of the designated public green areas and possible destinations did not explain their popularity: built-up and non-built-up grey areas (ID23, 25), parks connected to water (ID37) and non-built-up areas with half-open vegetation (ID36). The common denominator for these areas was that the children identified gathering places in all of them.

Perceived barriers

For the roads where official *traffic* data were available, the pupils marked all or parts of the roads in the Gudeberg area as 'dangerous'. Places registered as a traffic hazard by the children were also located along these roads. No traffic data were available for the main road leading to the south, but several adolescents marked it as dangerous. The main road from the Gudeberg area to Begby also has heavy traffic, and it was also considered dangerous.

The adolescents reported lack of lighting as an important factor hindering outdoor activities, high-lighting places either along main roads, shortcuts or underpasses. A greater number of such locations were registered in the Begby neighbourhood, where there were more shortcuts in the residential areas.

Perceived personal insecurity, mainly relating to intimidating groups of people, was also considered a barrier for outdoor use of the neighbourhood by the adolescents. The places they avoided for social reasons were in different locations but were mostly built-up areas. Social fears did not correspond to areas with special landscape characteristics but they were mostly reported from Gudeberg.

Are there characteristics of the urban landscape that promote or hinder certain kinds of use and pa among adolescents?

The landscape characteristics differed between the two neighbourhoods. These differences resulted in different activity patterns.

The terrain in the Gudeberg neighbourhood is flat, with varied housing areas and bigger industrial/commercial areas. The non-built-up areas are predominantly open cultivated areas, e.g. grassy areas, sports fields or agricultural fields with varying terrains (ID30, 31), but there are also bigger park areas (ID33, 34) (Figure 3).

The Begby neighbourhood lies in varied, hilly terrain. The residential areas mostly consist of single-family houses with an organic road layout and scattered, half-open vegetation (ID1). Various nature areas (ID27) and open cultivated areas (ID29) dominate the non-built-up areas (Figure 3).

The built morphology is more diverse in the Gudeberg neighbourhood than in Begby. The overall landscape character area type structure is thus more mosaic-like in Gudeberg and more homogeneous in Begby.

In Begby, there were more recreational areas for non-organised activities. A greater variety of activity types were registered here, but they were fewer in number (Figure 3, Table 2). In contrast, Gudeberg seems to support more activities related to meeting friends/hanging around (Figure 3, Table 2). A greater number of activity areas were marked and more different landscape character area types were used, but with less variety of activity.

Main findings

From the landscape point of view, we defined the actualised affordances for adolescents as landscape character area types where they engage in activities. By differentiating the neighbourhood landscapes on the basis of the activities, we identified two main groups of affordances:

- (1) Begby: (actualised) affordances for various activities,
- (2) Gudeberg: (actualised) affordances for getting together.

Begby: affordances for various activities

Based on the variety of registered activity types, the Begby neighbourhood can be considered an area that affords various activities (Figure 3): seven of the twelve activity types could be found in this area type (Table 2). All the analyses demonstrate that the *single-family housing area in an irregular layout and scattered vegetation in hilly terrain* (ID1) favoured outdoor activities. In the overview of registered activity types in Begby, both built-up and non-built-up recreational areas (ID14, 27, 29) seem to be important for facilitating different activity types, e.g. meeting friends, football, ballgames, horse-riding, skiing and shopping.

Outside the Begby neighbourhood, open grey or cultivated areas (ID25, 30) and areas typically associated with a recreational/commercial function (ID17) are also important for various activities, e.g. meeting friends, football, biking, horse-riding, ice skating and shopping.

Gudeberg: affordances for getting together

Most of the areas used were registered in the non-residential areas (Figure 3, Table 2). These areas comprise nature areas (ID37), non-built-up, half-open areas connected to residential areas (ID36), open grey areas (ID25) and sports fields and grassy areas (ID29, 30, 31). If we look specifically at the places that pupils have registered as being used for meeting activities (Table 2), Gudeberg appears to be an area for getting together. In some of the listed area types here (ID25, 36, 37), the park area around the fortress (ID34) and one urban area (ID5), located in the historical old town with mixed commercial/residential functions, also attracted many users.

Discussion

The main objective of our study was to explore how different urban neighbourhood landscapes influence everyday PA. Connecting the activity patterns to the landscape character area types illustrated the behaviour–environment relationship of the affordance concept (Gibson, 1977). The results suggest that, combined with the landscape approach, the affordance concept may be useful for interpreting differences in activity patterns on a neighbourhood scale.

The Begby area, which appeared to support various activities, had many qualities that are recommended for good urban planning in Norway (Bjørneboe, Norges, & Husbanken, 2000). Begby is adapted to the terrain, provides diverse areas for both organised and unorganised activities and favours outdoor play, with carefully designed green areas and a road layout aimed at calming traffic. A similar built-up environment (*Different kinds of dwellings, not too tall or ugly buildings/Low and small dwellings close to each other*) was reported as a child-friendly characteristic by Haikkola et al. (2007, p. 339) in a Finnish study. This type of environment appears to provide a broader range of outdoor facilities for PA, something Limstrand (2008) and Kytä (2004) also considered an important factor in relation to outdoor area use.

The reason for the predomination of the activity type *hanging around and meeting friends* in Gudeberg was perhaps that the area lacked the landscape variability of Begby. Besides, Gudeberg is an area that developed over a longer period of time without the overall spatial planning that defined the Begby area. It may also be the case that Gudeberg offers other opportunities for outdoor recreation that are suited to meeting friends. Socialising is one of the main reasons for adolescents participating in outdoor activities (Duzenli, Bayramoglu, & Ozbilen, 2010). Places for social interaction are not necessarily designed for activity; the important elements are outdoor settings '*allowing peer interactions in unstructured activities away from adult supervision*' (Schiavo, 1988, p. 9). Studies have also indicated that public spaces often do not suit adolescents' needs (Matthews, 1995). To some extent, this could be because adolescents are often regarded as undesirable in public spaces (Lieberg, 2006; Malone & Hasluck, 1998). In our study, the pupils made extensive use of areas for leisure-time activities that were not planned for PA.

In line with other results (Boone-Heinonen et al., 2010), our data showed that zoned outdoor spaces are quite important as gathering places. The popularity of sports areas was consistent with previous research results (Babey et al., 2008; Limstrand, 2008). The different park area types in our study that were reported as an affordance for spending time with close friends are in line with the findings of other researchers (Cohen et al., 2006; Duzenli et al., 2010; Simmons, 1994). Haikkola et al. (2007) found recreational facilities and the characteristics of the built environment and green areas to be the most important parameters in the physical environment for 11- to 12-year-old Finnish and Italian children.

In this study, the importance of the local city centre, which provides a wide variety of services, appears to support the findings of Clark and Uzzell (2002) and Duzenli et al. (2010), who found the city centre to be the most preferred urban area for adolescents.

Many studies indicated that, if safety is an issue, it might have an overriding influence on PA behaviour relative to other factors. General neighbourhood safety (Babey et al., 2008; Davison & Lawson, 2006; Ferreira et al., 2007; Grow et al., 2008; Mota, Almeida, Santos, & Ribeiro, 2005; Voorhees et al., 2010) and traffic safety/heavy traffic (Cradock, Melly, Allen, Morris, & Gortmaker, 2009; Davison & Lawson, 2006; Ding, Sallis, Kerr, Lee, & Rosenberg, 2011; Grow et al., 2008) were the priority issues. In our study, heavy traffic and lack of lighting were the most reported hindering factors. Nevertheless, in our case, the perceived danger did not seem to limit activities. The adolescents' activity patterns showed that, despite their concerns, they did use places they marked as having *heavy traffic* or *lack of lighting* or even areas associated with *social fears*. The reason for using non-safe areas could be a lack of alternatives (i.e. road connections), but our school neighbourhoods were generally safe. The reported safety issues therefore did not overrule the adolescents' behaviour.

The results of our study have some practical implications for urban planning. Variation in the outdoor environment is important for outdoor activities. The urban landscape should be planned so that it provides arenas for different (specific and spontaneous) activities, concerning both areas and connecting routes. Planning should not only focus on destinations, but also at least as much on active transportation systems between them.

Limitations

There are some limitations to this study. Due to the analysis method, the actualised affordances here contain 'places for interaction' as defined by Lieberg (2006). Places for 'retreat' (Lieberg, 2006) would require individual analysis of the PA patterns, which was not a priority in this study.

Socio-economic status (SES) is reported to have an influence on PA behaviour. Gordon-Larsen found that socio-demographic factors were more associated with inactivity than activity (Gordon-Larsen, McMurray, & Popkin, 2000). Limstrand (2008) showed that, in most cases, low socio-economic status was reported to be negatively associated with PA. It was not possible to collect individual SES data in this project. Because of the study design, i.e. selecting two neighbourhood areas in the same municipality, it was possible to reduce the inequalities in the macro environment.

Conclusion

The comprehensive landscape approach has made it possible to study the complex phenomenon of urban landscapes. The approach has also contributed to a better understanding of the patterns of activity. In our study, we found specific landscape characteristics that were associated with certain kinds of use and activities. We found neighbourhood differences in activity patterns. Our results appear to indicate that variety is an important quality of the outdoor environment in relation to promoting activity. Variety in affordances appears to be an important factor that influences PA behaviour. This insight should be taken more seriously in future research, planning and facilitation of PA among young people.

Variety in destinations and variety in landscapes seem to influence activity patterns differently. In our case, in the neighbourhood that had a greater variety of destinations for outdoor activities, (but that, from our landscape character perspective, was more homogeneous), more different activity types

were registered in fewer locations. In the neighbourhood with more varied landscape characteristics, fewer different activity types were registered, but in more locations.

We must keep in mind, however, that homogeneous landscape character means that areas with similarly composed characteristics, (e.g. small family houses in hilly terrain, natural vegetation and an organic road structure), resulted in one landscape character type, although the experienced variation of the environment might be high; this landscape type had many affordances for PA. On the other hand, different housing typologies in flat terrain, less varied vegetation and a grid road structure led to many different landscape character types.

Notes

1. barnetråkk in Norwegian.
2. Norge digital FKB database 32_0106bygg_flat.
3. In this study, we did not have permission to use the pupils' private addresses.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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