



# Nature as a facilitator for physical activity: Defining relationships between the objective and perceived environment and physical activity among community-dwelling older people

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## ABSTRACT

The aim was to study the correspondence between the objective and perceived environment and to assess their associations with physical activity (PA) in older people. 848 community-dwelling older people aged 75–90 were interviewed on their difficulties in walking 500 m, perceiving nature as a facilitator for outdoor mobility, and PA. The presence of water and landscape diversity were objectively assessed inside 500 m and 1000 m circular buffers around participants' homes. Using logistic regression, participant data were analyzed together with the objectively assessed environmental features. Our results indicate that higher habitat diversity within natural areas correlates with higher PA among older people without walking difficulties and the presence of water correlates with higher PA among those with walking difficulties.

## 1. Introduction

Regular physical activity (PA), especially outdoors, positively affects health throughout the lifecourse (Pasanen et al., 2014; Gladwell et al., 2013). Even moderately active compared to sedentary behavior decreases the relative risk of mortality (Löllgen et al., 2009). Walking outdoors, for example, improves the physical capability of older people, including those reporting difficulties in walking (Simonsick et al., 2005). Environmental factors play an important role in enabling or preventing outdoor mobility among older people (Eronen et al., 2014; Rantakokko et al., 2012). A higher number of facilitators in the environment of older people increases their likelihood of engaging in physical activity (Eronen et al., 2014) whereas perceived barriers in the environment predicts a decline in walking capability (Rantakokko et al., 2012). Places perceived as positive by older people are mostly located close to home (Laatikainen et al., 2017) and this is also where older people's PA mostly occurs (Chaudhury et al., 2016). Going out of home increases the PA in older people (Portegijs et al., 2015). With the growing number of older people in the population, understanding the environmental factors that facilitate their PA is increasingly important from the perspective of both the individual and society.

With age, the physiological and sensory capacities of people decline (Viljanen et al., 2012). Typically, perceiving difficulties in walking longer distances is the first sign of mobility decline (Rantanen, 2012).

Lower body function and walking difficulties thus merit consideration as they affect the way environmental factors are perceived (Sakari et al., 2017; Moura et al., 2017), how the perceived environment is related to PA (Levasseur et al., 2015; Haselwandter et al., 2015; Gallagher et al., 2012; Satariano et al., 2010), and how the objective features of the neighborhood are related to PA (Satariano et al., 2010; King et al., 2011; Gong et al., 2014). Clearly distinguishable patterns in land use and structures in the landscape can simplify extracting information from the environment (Kaplan and Kaplan, 1989). Similarly, according to the widely known person-environment fit (P-E fit) theory based on the ecological model of ageing by Lawton and Nahemow (1973), objective environmental features, personal capabilities, and perceptions of the environment are factors that largely determine older persons' prospects for engaging in a specific activity in the environment, such as walking. Based on recent review articles, the relationship between built and natural environmental features and PA (Harris et al., 2013) has been widely investigated, but only a few studies have simultaneously addressed the perceived and objective neighborhood environment and mobility limitations as factors underlying PA among older people (Levasseur et al., 2015; Haselwandter et al., 2015; Rosso et al., 2011).

Nature and green spaces (Levasseur et al., 2015; Rosso et al., 2011) and aesthetics (Levasseur et al., 2015; Rosso et al., 2011; Yen et al., 2014) can be considered important environmental facilitators for

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outdoor mobility among older people. The concept of landscape aesthetics often seems to overlap with nature: An environment perceived as aesthetic is commonly described with reference to the presence of trees, gardens, or vegetation in the landscape (Yen et al., 2014; McCormack and Shiell, 2011) and naturalness (Frank et al., 2013), all of which are aspects of nature. Drawing on the geospatial environmental data in the Geographic information system (GIS), perceived neighborhood features of these kinds have been operationalized into objectively assessed features of the natural environment, expressed in numerical values. Using GIS, high diversity and structural richness have been identified as key features of attractive landscapes (Schirpke et al., 2013; Tveit et al., 2006). Additionally, it has been suggested that when operationalizing green or natural environments as GIS measures, quality instead of proximity measures should be used (Ekkel and de Vries, 2017). On the question of spatial scale, large natural areas are suggested to offer a deeper experience of perceiving nature compared to small-sized areas (Ekkel and de Vries, 2017). Perceptions of nature and/or landscape aesthetics often correspond with the presence of water (Tveit et al., 2006; Dramstad et al., 2006; Dorwart, 2015) and with the measures of landscape diversity, such as patch density (Frank et al., 2013), number of land types (Frank et al., 2013), and the Shannon's Diversity Index (SHDI) (Frank et al., 2013; Dramstad et al., 2006). The presence of large natural areas with attractive features (Giles-Corti et al., 2005) as well as habitat diversity (de Jong et al., 2012), have also been proposed as potential correlates of PA. Among older persons with mobility limitations, however, the perceived and objective environmental determinants of PA continue to remain obscure (Levasseur et al., 2015; Satariano et al., 2010; Rosso et al., 2011). Also, studying perceived environmental features as connected with performing outdoor mobility would elaborate further knowledge on the facilitating effect of environmental determinants of outdoor mobility. Previous studies have shown that use and presence of environmental resources have different relationships with PA (Carlson et al., 2016). Few studies have focused on factors specifically motivating people to outdoor mobility.

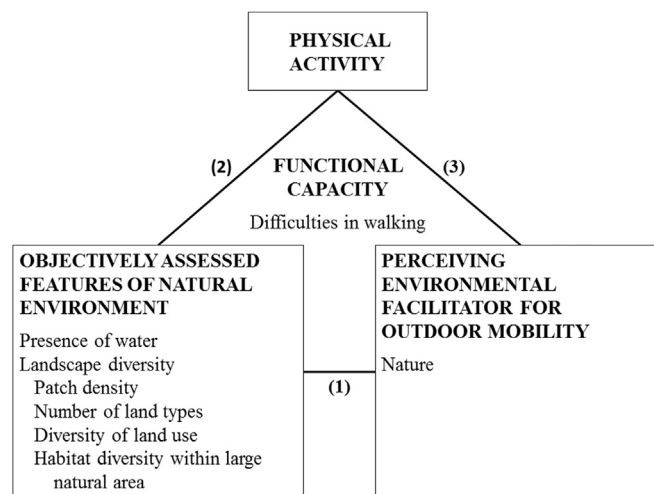
The purpose of this study was to further knowledge about how well objectively assessed features of the natural environment correspond to perceiving nature as a facilitator for outdoor mobility among community-dwelling older people and whether objective environmental features vs. perceiving environmental facilitator for outdoor mobility correlate with PA. Our framework was based on the P-E fit theory (Lawton and Nahemow, 1973), and we considered difficulties in walking as the principal dimension of functional capacity in older people (Fig. 1).

Our study had three aims: (1) to find out how objectively assessed features of the natural environment are related to perceiving nature as an environmental facilitator for outdoor mobility; (2) to investigate the associations between objectively assessed features of the natural environment and PA; and (3) to examine whether perceiving nature as an environmental facilitator for outdoor mobility is related to a higher level of PA.

## 2. Method

### 2.1. Study design

This cross-sectional study is part of the project "Geographic characteristics, outdoor mobility and physical activity in old age" (GEOage). In the study, participant data, including self-reports of perceived environmental factors, functional capacity, and PA, were linked to a set of objectively assessed features of the natural environments of the participants. Data reported by older people, collected as part of the baseline assessments of the "Life-space mobility in old age" (LISPE) cohort study, were used and have previously been described in detail (Rantanen et al., 2012). Participants were community-dwelling older people aged 75–90 years living in the municipalities of Jyväskylä



**Fig. 1.** The study framework was based on the person-environment fit theory and describes the associations between (1) objectively assessed features of the natural environment and perceiving environmental facilitator for outdoor mobility, (2) between objectively assessed features of the natural environment and physical activity, and (3) between perceiving environmental facilitator for outdoor mobility and physical activity, all three of which are affected by the functional capacity of the person.

and Muurame in Central Finland, where high numbers of lakes and hills are the predominant topographic features of the area. A random, non-spatial sample of 2550 people was drawn from the national population register and informed about the study by letter. A total of 848 people who were willing to participate, lived independently and were able to communicate were interviewed in their homes in 2012. All participants signed a written informed consent before interview.

Participants' homes were then located on a map by geocoding their addresses using the Digiroad 2013 dataset (dataset, 2013a) in ArcMap 10.3 software. Manual geocoding was required for 16 participants, who were not automatically located. Objectively assessed features of the natural environment were defined in GIS based on geospatial data on land use and topography within circular neighborhood buffers of 500 m and 1000 m radius around the participants' homes. The 500 m distance has been proposed by the European Commission Expert Group on the Urban Environment to serve as a common indicator for a walkable distance to public open areas. The distance of 500 m is expected to correspond to a 15-min walk for older people (European Commission, 2001). A 1000 m distance was also used since environmental features located further away may also be relevant facilitators for PA (Villanueva et al., 2014), especially among those without difficulties in walking. The LISPE project and the GEOage project have been approved by the Ethical Committee of the University of Jyväskylä, Finland.

### 2.2. Participant measures

#### 2.2.1. Difficulties in walking

Difficulties in walking were assessed by asking "Are you able to walk 500 m?" The response options were (a) able without difficulty, (b) able with some difficulty, (c) able with a great deal of difficulty, (d) unable without the help of another person, and (e) unable to manage even with help. For the analysis, the responses were dichotomized into no difficulties (a) and difficulties (b-e). Self-reported difficulties in walking 500 m has been shown to be a valid measure to capture mobility limitations (Mänty et al., 2007).

#### 2.2.2. Perceiving nature as a facilitator for outdoor mobility

Perceiving nature as a facilitator for outdoor mobility was obtained from one item of a checklist on environmental facilitators for outdoor mobility (PENFOM) (Rantakokko et al., 2015). The PENFOM checklist

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