

Rethinking Accessibility in Planning of Urban Open Space Using an Integrative Theoretical Framework

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Abstract: Arguably, accessibility to urban open spaces, including parks, is said to contribute to community wellbeing and a healthier urban lifestyle. Accessibility, however, is a complex concept. It is difficult to define and more difficult to measure. While accessibility has now evolved into a multi-dimensional construct, current open space planning models still use physical proximity to an open space area as proxy variable to evaluate 'accessibility'. This approach, however, tends to overlook the complexity of the 'accessibility' concept. This paper, therefore, proposes an integrative theoretical framework to better illustrate the relationships between open space accessibility and use, within the context of urban open space such as parks. Two processes are described in this framework: (1) a psychological process wherein accessibility to places results from the evaluation of both physical and social- psychological accessibility variables and (2) a behavioural process wherein perceived accessibility influences human behavioural intention to use (or not use) specific urban open spaces. Furthermore, we develop two models to illustrate these processes: (1) an integrated model of open space accessibility containing both spatial and non-spatial dimensions and (2) an expanded planned behavioural model that includes the perceived accessibility construct. These theoretical models provide an alternative framework in gaining a better understanding on the multi-dimensionality of the accessibility construct and its impacts on open space use behaviour.

1. Introduction

By year 2050, over 75% of the world's population will live in an urban environment. This is accompanied by an ever increasing demands for urban public services (UN, 2012, UNFPA, 2011). Urban public services and facilities, such as public parks and open spaces, are vital to the quality of life of city dwellers. Scholarly literature supports the notion that public open spaces are critical physical environments that foster active lifestyles and encourage physical activities (Sallis et al., 1997, Hoehner et al., 2005). Taken as an important public health promoting facility, urban parks and open spaces are claimed to contribute to community wellbeing, encourage a change of sedentary lifestyle (Cohen et al., 2007), and contribute towards the development of social capital and healthy cities (Chiesura, 2004, Jones et al., 2009). It, therefore, becomes imperative that the provision of urban parks and open spaces is accompanied by a fundamental need for ensuring adequate access to such facilities.

Some mega-cities, for example Mexico City, have given high priority to increase the access of residents to public parks and urban open spaces to achieve the aim of not only creating healthier and more sustainable urban lifestyle (UNFPA, 2011) but also providing inclusive urban facilities. Equitable open space distribution requires no systematic differentiation in park access across areas and across populations (Maruani and Amit-Cohen, 2007, Neutens et al., 2010). In addition, effective open space management and planning requires a clear understanding about the concept of accessibility, however, existing knowledge about open space access is incomplete, especially at the individual perceptual level (Kruger et al., 2007). Extensive evidence demonstrate inconsistencies between subjectively measured (perceived accessibility) and objectively measured (geographic accessibility) accessibility to open spaces (Ball et al., 2008, Hoehner et al., 2005, McCormack et al., 2008, Scott et al., 2007, Jones et al., 2009), making it crucial for a better understanding of the factors, both qualitative and quantitative, that influence people's perception of accessibility. Furthermore, Joerin et al (2005) asserted that accessibility is mostly behavioural and therefore, is able to predict human behavioural changes. Nevertheless, to date, relatively little research has been devoted to examining the accessibility concept from the perspective of potential users and its role as a potential determinant that contributes to people's use behaviour.

The dependence of open space planning practice on the use of quantitative standards (e.g. distance/proximity and park area per capita) to design open spaces has proved limiting (Byrne and Sipe, 2010, Maruani and Amit-Cohen, 2007). This approach tends to overlook the complexity of the

'accessibility' concept. Although operationalization becomes relatively easy and understandable in practice, it cannot adequately address users' needs or represent people's perception of open space accessibility (Byrne and Sipe, 2010). Accessibility is a complex concept. It is difficult to define and more difficult to measure. Accessibility has now evolved into a multi-dimensional construct, consisting of variables that come from both spatial and non-spatial dimensions (Wang et al., 2013, Bisht et al., 2010) to be able to capture the complexity of social systems.

This paper, therefore, presents an integrative theoretical framework to better illustrate the relationship between accessibility and use, within the context of urban open spaces such as parks. It aims to address the following questions: Which criteria are worth including in an open space planning model? How do these criteria relate to open space use? This paper premises that this step is critical to be able to attain a clearer understanding about the concept of accessibility and potentially establish the relationship between park access and park use behaviour.

The remainder of this paper is arranged in the following manner: in section 2, we begin by comparing popular planning models that are currently used in planning for urban open spaces. Our aim is to identify the role of accessibility in contemporary open space planning practice to rationalise the need for a more comprehensive understanding about the concept as well as its relationship with other important planning concepts, including place use. Section 3 presents an integrative framework for urban open space use revealing the interrelationship amongst these important planning concepts. Two processes are described in this framework: (1) a psychological process results from the evaluation of both physical and social-psychological accessibility variables; and (2) a behavioural process wherein perceived accessibility influences human behavioural intention to use (or not use) specific urban open spaces. In section 4, we adopt an integrated park accessibility model arguing that such a representation is a more authentic articulation of the multidimensional concept of accessibility. Section 5 examines perceived accessibility as a predictor that contributes to open space use, and proposes an expanded behavioural model that explains the relationships between place use and accessibility. This is then capped with the paper's conclusion and future studies.

2. Accessibility in urban open space planning

2.1. Urban open space and planning models

Urban open spaces refer to the type of open space that has maximum human interference with the natural environment and highest level of accessibility for populations (Maruani and Amit-Cohen, 2007). Examples include urban squares and plazas, urban parks and community gardens, etc. This type of open space is commonly found within or adjacent to urban built up areas with an ultimate aim to fulfil urban population's recreation needs (Gold, 1973, Chiesura, 2004). Urban open space planning, therefore, must take into consideration attributes of the target population such as demographic variables, density, values and preferences, etc. However, do the current planning models used to plan for parks and open spaces adequately address such diverse demands? This section, therefore, analyses current urban open space planning models to identify key planning criteria utilised by these models to measure access to parks and open spaces.

Urban planners use planning models as practical tools to achieve specific planning objectives. According to Maruani and Amit-Cohen (2007), three models are identified, with each having an identified focus in the planning of open spaces in cities. These are: opportunistic model, space standards model and park system model. Opportunistic model refers to land acquisitions that are considered as due to opportunities rather than systematic planning outcomes. Opportunities may arise in different instances, through land donation, demolitions, transformation of recycling sites and use of left-over space (Maruani and Amit-Cohen, 2007). A number of well-known parks have evolved based on this model, including as outcomes of using this model (e.g. Central Park in New York city). Nevertheless, opportunistic model is hardly considered as a systematic planning tool because of the lack of planning principles in the model and also, opportunities are largely due to chance.

Space standards model, on the other hand, is guided by quantitative matching between open space units (e.g. size and number) and population size in target area. Its guiding principle is to provide minimal amount of open space per capita for target population. While this model's simple operationalization has led to its worldwide expansion since being first introduced in the 19th century (Maruani and Amit-Cohen, 2007), it is now being criticized because of its disregard of the complex social and environmental systems. This criticism, however, has been addressed by the park system model, which promotes a systems approach towards urban open space planning. The park system model holistically considers the interrelationship of parks and gardens that supports continuous

movement within the system. Beyond quantitative standards, park system model emphasizes proximity to users and the variety of user experiences in different types of urban open spaces, from small community gardens to large metropolitan parks.

Contemporary urban open space planning models, while being concerned with questions like how much, what type of and where open space should be provided, reveal that quantitative parameters (e.g. population size, spatial location and distance) are the most common measures utilised to determine open space access (see Table 1 for the comparative summary of the key criteria used by the three models), failing to consider other elements that would assist in authentically reflecting people's perspectives.

Table 1. Key Variables Addressed in Urban Open Space Models

<i>Urban Open Space Planning Models</i>	<i>Objectives</i>	<i>Open space variables</i>	<i>Population variables</i>	<i>Random or planning</i>
Opportunistic model	Open space provision as a result of opportunities			Random model
Space standards model	Open space provision as units per capita of target areas	Open space size Open space number	Population size	Planning model
Park system model	Open space provision interrelated system	Open space size Open space type Connectivity	Population location Distance to users	Planning model

2.2. Accessibility as an indicator focused on users' need

Given the focus on ensuring community wellbeing, urban open space planning must relate to a variety of parameters that focus on user's needs. Maruani and Amit-Cohen (2007) identified 'accessibility' as one such parameter that has the capability to address people's needs (Maruani and Amit-Cohen, 2007). Defined as the ease with which people can reach desired activity sites (Johnston et al., 2009), accessibility has been widely used as an important indicator to evaluate the extent to which planning has been able to adequately respond to population's demand for urban open space. As revealed in Table 1, however, modern planning practice largely relied on quantitative planning standards to measure communities' access to urban open spaces. Besides population size, few other population attributes have been taken into accounts. Little evidence has been provided to support that objectively measured accessibility can adequately address the diversity of people's needs to access urban open spaces, which are largely determined by populations' demographic characteristics, values and personal preferences.

Increasing evidence shows that accessibility does not always equate with quantitative spatial measures. Using the theory of island biogeography as an analogue, the theory of urban park geography posits that while both distance and size of park exert impact on the diversity of park values. Brown (2008) found a relatively weak relationship between distance and park value when using Anchorage survey data to empirically test the theory (Brown, 2008). This finding indicates that accessibility, which is a much more complex construct than geographical measures of distance, might confound the relationship between distance and park value. Other empirical evidence indicated that geographic accessibility measures showed poor consistency with subjective-measured accessibility to urban open space, (Ball et al., 2008, Hoehner et al., 2005, McCormack et al., 2008, Scott et al., 2007, Jones et al., 2009, alluding to the presence of other factors (e.g. social-psychological factors) which may affect open space accessibility, and ultimately, open space use.

The end goal of urban open space planning is to address users' demand for open space. This then creates the need to develop a more comprehensive understanding of the accessibility concept, especially at the individual perceptual level. However, to date, there is a lack of knowledge in open space planning literature about accessibility dimensions and variables, its relationship with people's use behaviour, and its interactions with other factors that may influence people's use behaviour. This paper fills these knowledge gaps by examining the accessibility concept from the perspective of

potential users. It posits that the human process of evaluating accessibility is key to understanding the accessibility dimension, its variables, as well as its relationship to open space use behaviour. To accurately describe these socio-psychological processes, we present an integrative framework for urban park use in the next section. The rest of this article is dedicated to explain this framework and the two models that were then derived from the framework.

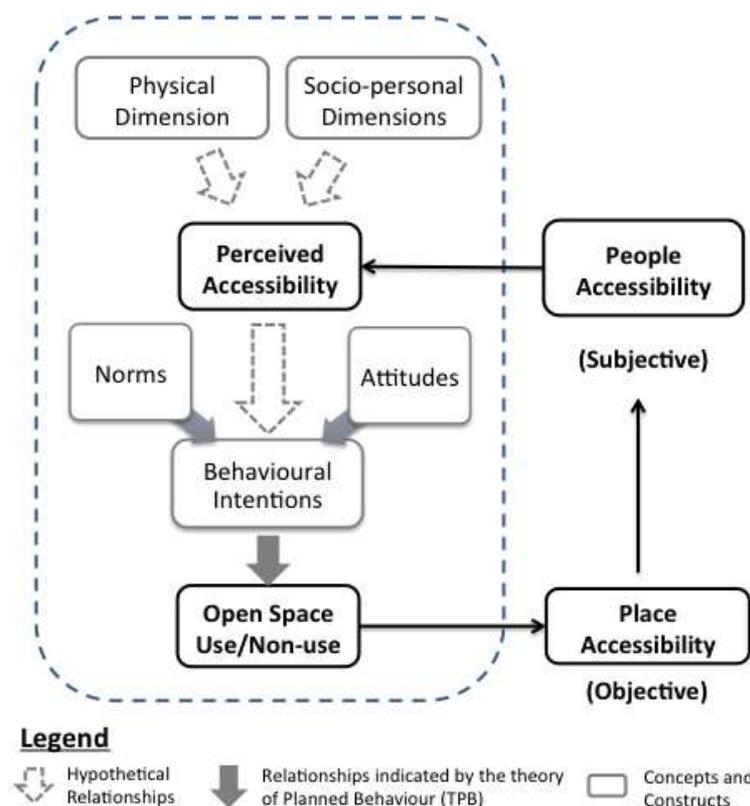
3. The integrative framework for urban open space use

The examination of the relationship between open space accessibility and open space use leads us to the dichotomy of place versus people. Place accessibility and people accessibility represent different research foci in accessibility research (Murray et al., 2003, António and Peter, 2007). While 'place accessibility' researchers conceive geographical access as a location attribute, people accessibility researchers, on the other hand, focus on the ability of different groups of individuals to access the open space (Murray et al., 2003). This suggests that place and people accessibility are different representational frameworks that provide different operational definitions for accessibility. The decision on which perspective a researcher takes is critical because it determines which accessibility measures will be adopted in the study. Similarly, Horner (2004) distinguished the two perspectives by explaining the different purposes of these measures. Place accessibility measures examine levels of attractiveness of places or locations to all its possible users, which implies that access is an intrinsic feature of location, while people accessibility can be viewed as an individual attribute and consequently measure the ability of people to reach and engage in opportunities and activities (Farrington and Farrington, 2004, Horner, 2004). In contrast, António and Peter (2007) argued that place and people accessibility are not mutually exclusive concepts, but outcomes from the same 'accessibility process'. Using five approaches to describe the accessibility process, each approach is considered to represent a relatively self-contained understanding of accessibility construct and has the ability to diminish or promote level of access for both individuals and place (António and Peter, 2007).

To capture the interdependent relationship between people and place accessibility, we adopt António and Peter (2007) conceptualisation of the accessibility process and concur that people accessibility and place accessibility are not mutually exclusive concepts, but different 'points of view' within the same accessibility spectrum. However, in this process, individuals' use behaviour acts as an important mediator to explain the relationship between these two concepts. From the perspective of potential service users, accessibility is the outcome of people's integrative evaluation of multiple influential factors, both spatial and non-spatial, which then influences the degree of access to facilities, including to urban open spaces. On the other hand, place accessibility regards a site as inaccessible even if it is within certain distance to a population but not one individual actually utilises it. In this paper, place accessibility is defined as the extent to which people utilize the place, representing the objective perspective of the accessibility process. Pirie (1979) argued that it is people's use behaviour that creates place accessibility, positing the relationship between place access and place use. Given this premise, place accessibility is the objective outcome of the accessibility process that is defined by individuals' use behaviour, rather than certain geographic constraints or barriers such as distance and transport (Pirie, 1979).

We illustrate the relationship using an integrative framework (**Figure 1**). The framework consists of four major components: people accessibility, perceived accessibility, place use/non-use behaviour and place accessibility. In our model, the term people accessibility refers to a cognitive /affective process that people evaluate their level of access to specific facilities, such as an open space and park, through the integrative evaluation of both physical and social-psychological accessibility dimensions. The formation of people's perceived accessibility informs their intent to use specific urban services or places. As Penchansky and Thomas (1981) argued, an individual's perception of accessibility may diminish or promote the use of urban facilities or services (e.g. open spaces) through behavioural choices. We therefore hypothesize that perceived accessibility is an important explanatory predictor of people's behavioural intention for place use or non-use decision that ultimately define the concept of place accessibility.

Figure 1. The Integrative Framework For Urban Open Space Use



The left part of the framework further explains the relationship between accessibility and place use. People's judgement, on which place or service is more accessible in comparison to other places, initiates an integrated evaluation process. This process considers, evaluates and incorporates multiple accessibility variables, both physical and social-psychological. The subjective evaluation of personal accessibility is then combined with other subjective components (e.g. norms and attitudes) leading to behavioural intentions or actual use behaviour towards accessing a place or service that contributes to place accessibility. This framework reveals that accessibility and place use are not independent concepts, but interactive constructs. If the conditions associated with different dimensions of accessibility change, individuals will then re-evaluate to modify their perception of accessibility to places or services that will ultimately influence their use behaviour.

This framework is important because it reveals relationships between accessibility and place use, and identifies variables that may influence these two constructs. Accessibility, as illustrated in the figure, does not equate with place use. Rather, it acts as only one of potential explanatory variables, together with other important subjective components, contributing to people's use of public facilities and services. Therefore, planners should identify important variables that are addressed in the framework to achieve equitable distribution of services based on accessibility. As mentioned above, accessibility is a multidimensional construct that has been evolved far beyond its geometric origins. So, what are the potential variables that influence people's perceived accessibility to urban open spaces? Which criteria are worth including in an open space planning model? How do these criteria relate to open space use? Seeking answers for these questions creates a need for more specific theoretical models to facilitate an empirical research design. Section 4 and Section 5 will develop this framework further into two models using urban open space such as urban parks as specific study context.

4. Accessibility as a multidimensional construct

Accessibility as a concept has shifted from a spatial-physical focus to the consideration of a more non-spatial dimension. This section discusses this paradigm shift while proposing a preliminary model for perceived accessibility to urban open space.

Traditionally, accessibility research has focused on impacts of geographic space on the spatial patterns of human activities (Larkin and Peters, 1983, Hass, 2009). This has generally examined urban system performance based on two key variables: 'physical distance' between service provider and user convenience and 'ease of overcoming distances' (i.e. transportation availability) (Marten and Gillespie, 1978, Nicholls, 2001). This is also reflected in how the concept is defined. For example, the

2nd edition of the Dictionary of Human Geography (hereinafter referred to as the Dictionary) published in 1986, defined accessibility as the ease with which a site may be researched or obtained, with distance being the only addressed variable measuring accessibility (Johnston et al., 1986). However, there was still that recognition for the need to develop a more conceptually robust and incisive notion of accessibility, which was as important as improving accessibility measurement (Pirie, 1981).

The conceptualisation of accessibility is, however, continually evolving to respond to the changing environment as well as to adapt to the increasingly multi-disciplinary nature of the planning discipline. The 'accessibility' concept has now been adapted in a number of fields outside the Geographical discipline to include not only its physical attributes but also other critical dimensions such as social, information availability, among others. Likewise, this shift has been recognized and incorporated in how the concept has been further refined and defined in subsequent editions of the Dictionary. In the fourth edition (2000), the standard definition of accessibility was "the ease with which one place can be reached from another which broadened the concept to include interactions with other places and services, transport and communication constraints, and other social-economic barriers"(Gregory et al., 2000)). This was further broadened in the latest edition of this dictionary (5th edition published in 2009) to include more non-spatial variables such as information available, language and culture barriers, education and skills, and other social-economic barriers. Interestingly, the focus of accessibility, as gleaned from how it is defined as "the ease with which people can reach desired activity sites, such as employment and urban parks" (Johnston et al., 2009)), has moved from places to people. Certainly, there is recognition that the notion of accessibility has become broader and more complex, therefore, requiring an increasing conceptual emphasis on the non-spatial dimensions.

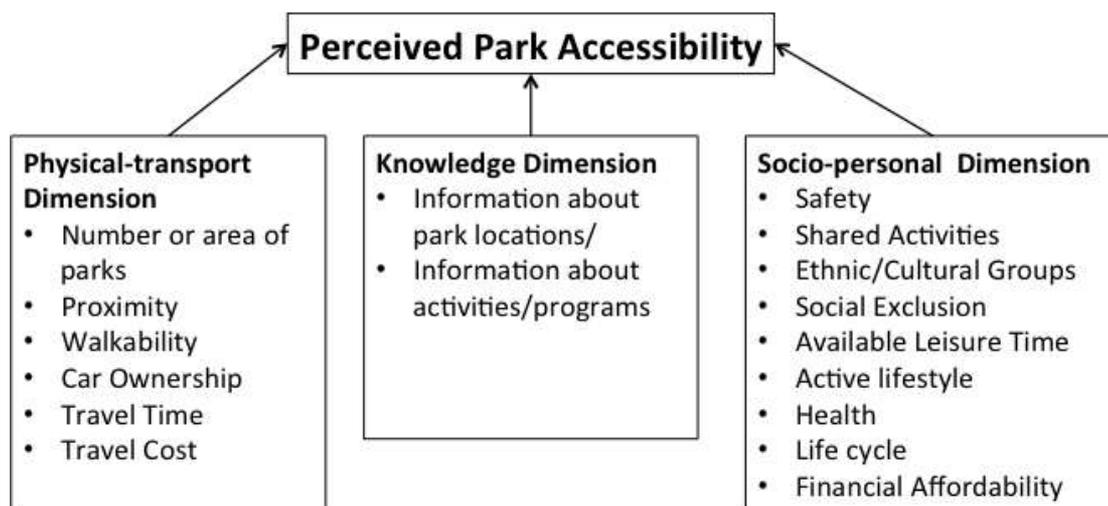
Established scholarly literature demonstrated the shifting conceptual focus of accessibility from spatial to non-spatial dimensions. For example, Aday and Andersen (1974)'s research investigated the key socio-organizational and geographic aspects of accessibility. They argued for a wider definition of accessibility, which should extend beyond physical geographical accessibility and take into consideration the impact of financial, informational and psychological conditions of service users (Aday and Andersen, 1974). Their views were further supported by Marten and Gillespie (1978), who argued that social barriers and user characteristics should be integrated with geographical factors to represent public service accessibility. Gulliford et al (2002) distinguished "having access" from "gaining access" to develop better understanding of the accessibility concept. Whilst the former one refers to physical accessibility, which is dependent on the adequacy of supply the latter is more concerned with the extent to which people have the capacity to overcome various barriers to make use of services. Besides physical accessibility, Gulliford et al (2002) proposed three non-spatial aspects (i.e. financial, organisational and social or cultural barriers) that may impact people's ability to access public facilities. They argued that any research investigating accessibility disparity should at least take into account these four aspects of the concept. Contemporary research continues to address the complexity of accessibility concept and argues for a more integrated discussion. Bisht et al. (2010) claimed that non-spatial dimensions are integral parts of accessibility. They posited an operational definition of accessibility that consists of mobility, information, and development as three major dimensions. António and Peter (2007) argued for a more comprehensive discussion for public service accessibility wherein a five-layer model of accessibility confirms the multi-dimensional nature of the concept but places more emphasis on personal barriers and perception constraints.

While spatial approaches are still the most prevalent measures for accessibility in contemporary park studies (Higgs et al., 2012, Weber, 2006), the availability of spatial data and the increasing analytical capability of computer systems have encouraged great advances in accessibility measurement (Weber, 2006, Murray et al., 2003, Neutens et al., 2010). The advent of Geographic Information System (GIS) has also significantly improved the analytical capacities and made new methodological advances possible (see for example (Higgs et al., 2012) wherein the use of network analysis provides more accurate measure for transport distance). Nevertheless, these methodological advances in spatial analysis have not successfully addressed the multidimensional nature of accessibility concept, leaving non-spatial dimensions largely unexplored.

In Figure 2, we propose an integrated conceptual model which represents park accessibility from an individual perceptual perspective. The model critically incorporates potential influencing factors for urban open space accessibility. Also, it encompasses both spatial and non-spatial dimensions, as a more authentic representation of the accessibility construct, including user characteristics, social barriers, information of facilities, proximity and availability. These factors are assumed to potentially

influence people's evaluation process to form their perceived accessibility to urban parks and open spaces

Figure 2. A Conceptual Model for Perceived Park Accessibility



5. An extended planned behaviour framework to explain open space use

This section extends the integrative framework for urban open space use wherein we propose an extended planned behavioural model to further develop the role of perceived accessibility in contributing to user's behavioural change.

Urban open space is one of most important environmental elements that helps foster active lifestyle and contributes to both physical and mental health (Chiesura, 2004, Cohen et al., 2007, Coutts, 2008). While there is increasing interests in examining the impact of people's accessibility level on open space use (Coutts, 2008, Cohen et al., 2007, Schipperijn et al., 2010, Wolff and Fitzhugh, 2011), research to date has heavily relied on objective measurement of park accessibility and park use (Cohen et al., 2007, Coutts, 2008, Erkip, 1997). For example, these studies utilised direct observation to measure open space use and physical activities and GIS-based analysis (e.g. LUPTAI, distance to user, travel time) to determine the extent to which an area is considered accessible (Comber et al., 2008, Nicholls, 2001, Pitot et al., 2006). In addition, few studies specifically focused on access to parks and green space for people of different social-economic background to examine disparity of spatial distribution of green spaces for social disadvantaged groups. Findings suggest a worldwide problem of inequitable distribution of urban parks and green space within cities (Zhang et al., 2009). Some studies found that minority neighbourhood are more vulnerable to poor access to public parks and degrading public recreation facilities (Estabrooks et al., 2003, Macintyre et al., 2008). Significant association was confirmed by empirical results between higher poverty rates and reduced availability of green spaces. These findings, however, contrast with others who reported or that the provisions of open spaces had no significant associations with deprivation; that respondents living more deprived areas had higher potential physical access to green spaces but with poorer perceived accessibility and less frequent use (Jones et al., 2009, Macintyre et al., 2008). The disparity among these findings suggests subjectively measured accessibility might be a more effective measure in predicting open space use behaviour. In addition, extensive studies have reported significant mismatch between objectively measured accessibility and subjectively measured accessibility to urban open space, especially for disadvantaged population groups such as residents living in deprived areas (Ball et al., 2008, Hoehner et al., 2005, McCormack et al., 2008, Scott et al., 2007, Jones et al., 2009).

Also, perceived accessibility is premised to have an important role in explaining and predicting use behaviour (Joerin et al., 2005). Perceived accessibility is used to measure the extent to which individuals consider the service is accessible to them, representing the subjective nature of accessibility. Zondag and Pieters (2005) argued that use behaviour cannot be isolated from perceived accessibility. They emphasized that every individual and household has his own perception of accessibility for public facilities. Affected by people's valuation of destination suitability, perceived accessibility provides a more reliable measure of people preference and diversity of user's needs,

Subjective measures such as behavioural intention provides the best predictor to human behaviour (Rossi and Armstrong, 1999, Fishbein and Ajzen, 1975), however few researchers in the field of urban open space planning grounded their study in behavioural theories to investigate the relationship between accessibility and self-reported behavioural intentions. This paper, however, contends that examining this relationship may pave the way towards a more efficient identification of influential factors to park use.

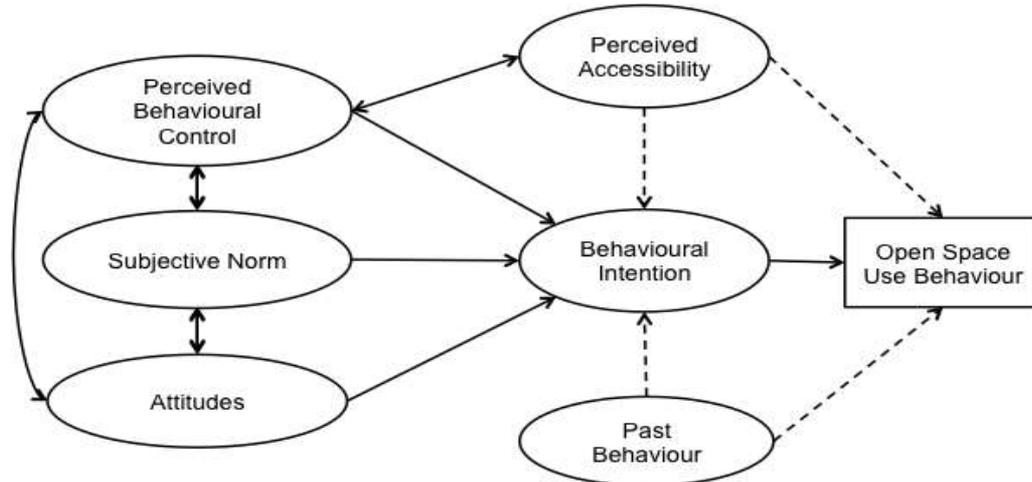
Central to the theory of planned behaviour (TPB) is the concept of behavioural intention. Behavioural intention refers to the motivations that lead to the engagement in a behaviour (Fishbein and Ajzen, 1975). It is assumed that behavioural intention is the immediate determinant of a particular behaviour: the stronger the behavioural intention is, the more likely a person performs certain behaviour (Ajzen, 1991, Bamberg et al., 2007). In the TPB model, behavioural intention is a function of three independent constructs: *Attitude towards behaviour (A)*, *Subjective Norm (SN)* and *Perceived Behavioural Control (PBC)*. Individual's *Attitude* towards a specific behaviour is obtained from the combining measurement of individual's beliefs to the salient attributes of certain behaviour and his/her subjective evaluation these attributes as consequences resulting from the performance of the behaviour. *SN* refers to people's perception of appropriateness to perform the behaviour with regard to general social pressures from salient referents (Rossi and Armstrong, 1999). *PBC* is included in the model in order to deal with the circumstances where constraints exist for behaviour (Ajzen, 1991, Ajzen and Madden, 1986)

TPB and its predecessor, theory of reasoned action (TRA), have been used to examine a variety of human behaviours (e.g. tourist behaviour (Hsu and Lam, 2004), travel behaviour (Bamberg et al., 2007), participation in leisure activities (Ajzen et al., 1995), pro-environmental behaviours, natural resource related human behaviour like hunting and fishing (Scherer et al., 2011, Rossi and Armstrong, 1999), there is a lack of direct references of TPB in open space study. However, various studies have confirmed the effectiveness of TPB in predicting leisure-related behaviour (see for example Ajzen et al. (1995) examine people's intention to participate in six leisure activities; Galea and Bray (2006)'s research supported its sufficiency in predicting human behavioural intention to participate in walking activities). Also, TPB is an open-ended model that can be extended according to the change of target behaviour. For example, as a "user-friendly" model, TPB was used by Gretebeck et al., (2007) to test intention and self-reported physical activity behaviour of older adults. Similarly, past behaviour is included in the model of TPB to explain tourist behaviour and is found to be associated with respondents' travel intention (Hsu and Lam, 2004). An extended version of TPB demonstrates higher capability to explain various behaviours for different population groups. Ajzen (1991) further claimed that base variables in the model (e.g. attitude, subjective norm and perceived behaviour control) can and should be broken down, rearranged and extended to meet researcher's specific need. Any constructs that are able to increase the power of behaviour prediction and explain additional variance in behaviour intention belong to this model.

Extending the TPB model, Figure 3 represents an extended behavioural model for open space use. Two additional factors were included into the model to explain the behaviour of urban open space use: 'perceived accessibility' and 'past behaviour'. As demonstrated above, existing literature has highlighted the potential role of perceived accessibility in explaining and predicting use behaviour. However, few researchers treated perceived accessibility as an influential component to behavioural intention or examined it with other behavioural determinants to explain use behaviour. In this model, perceived accessibility interacts with perceived behavioural control and acts as one of hypothetical subjective components that may contribute to the formation of behavioural intention and ultimately use behaviour. Past behaviour is another important factor to explain open space use behaviour. Not all human behaviours are carried out through conscious decision-making process. People do not have to consciously guide their actions when they perform habitual behaviour such as physical activities. Perugini and Bagozzi (2001) suggested that if behaviours are well-practiced and recurred in constant contexts, the frequency of past behaviour, a reliable indicator of the strength of habit, provides direct predictor to future behaviour. The inclusion of past behaviour in TPB was able to greatly improve the model's predicting ability to various behaviours in leisure studies (Hsu and Lam, 2004, Kitamura et al., 2001, Perugini and Bagozzi, 2001). Similar to other leisure activities, open space use behaviour are conducted in stable and constant contexts and can be considered as one of routine activities in people's everyday lives. In view of open space use as the target behaviour, it is reasonable to hypothesize that a 'past behaviour' variable will increase the amount of variance explained in open space use intention. Therefore, the model includes 'past behaviour' as a hypothetical explanatory variable with direct influence to both 'behavioural intention' and 'use behaviour'.

This model further illustrates the potential role of perceived accessibility as a predictor to open space use behaviour, as well as its interactions with other important subjective components in TPB model. This model provides for empirical testing. All the factors in the model can be measured using empirical research design to test their contributions to open space use.

Figure 3. An Extended Behavioural Model for Urban Open Space Use



6. Conclusion and future studies

Urban open space planning aims to allocate parks and greenspace to meet urban residents' demands for recreations. Accessibility is central to the urban planning discipline in general and urban open space delivery in particular. Our analysis suggests that current planning models are largely based on quantitative indicators that hardly represent the diversity of user's need and population demands. This paper suggests open space planning can be enhanced by recognizing the integrative framework of open space use to further current knowledge about the concept of accessibility and its process. Our framework reveals the relationship between accessibility and open space use from the perspective of potential users. It highlights people's evaluation process of the constraints associated with different accessibility dimensions, and the potential role of accessibility as predictor to people's use behaviour. Two additional models are proposed to elaborate the two individual but interrelated steps in the framework, adapting to urban open space and park as specific study context. These include (1) a conceptual model of park accessibility as more authentic representation of the concept in urban open space context and (2) an extended behavioural model for urban open space use that indicates causal relationship between accessibility and use behaviour. The first model presents a logical extension of existing definitions from the accessibility literature, while the second model is built on a behaviour theory with recognized power for behaviour prediction.

It is recommended that open space planning should go beyond physical indicators to gain more understandings about the diversity of users' preference. The proposed models will facilitate planners to explain the inconsistency between subjectively and objectively measured open space accessibility; to identify potential variables that may influence people's open space use, and therefore worth including in an open space planning model; to address the diversity of significant predictors to use behaviour in regards to different population groups. The proposed models will require testing, validation, and refinement. Both models present the ability to empirically test and validate using survey data in a variety of urban settings. Further research questions include: which dimensions and dimensional variables are most significant in contributing to perceptions of park accessibility? Does perceived accessibility actually predict park use behaviour? How much park use behaviour can be explained by the physical-spatial dimensions of accessibility compared to the social and personal dimensions? Does this model apply to different urban, social, and cultural settings?

In the real world, Accessibility is not an abstract concept in everyday life. This paper uncovers people's evaluation process on multiple factors that ultimately contributes to individual's behavioural choices. Research to evaluate the validity of the models presented herein will enhance our understanding of the conditions that lead to the use (or non-use) of urban open space to inform future planning decisions.

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