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The Walkable Neighborhood: A Literature Review

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Abstract

The past decade has seen a surge of interest in the walkable neighborhood, motivated by environmental, health, economic, and communitarian goals. We take stock of this literature by linking together the various strands of research in which the "walkable neighborhood" is a primary concern. We organize the literature into three broad categories: measurement, criticism, and tests of the benefits of walkable neighborhoods. The latter category involves three primary claims. We find that claims about social impacts are the weakest in terms of research support, in part, because there continues to be a problem of self-selection and an inability to assign causality.

Keywords: *Walkability, neighborhoods, sustainability*

Introduction

The past decade has seen a surge of interest in the walkable neighborhood. Motivated at first by the environmental goal of encouraging pedestrian over car-based urbanism, the walkable neighborhood is now regarded as a key factor in the promotion of health, economic, and communitarian goals. Blogs and magazines capture the cultural interest with articles like "The Crisis in American Walking" (Vanderbilt 2012; see also Speck, 2012), while organizations like Walkinginfo.org and America Walks[1] publish ratings of walkable communities and keep track of walking statistics like pedestrian injuries. In addition, there is growing scholarly literature on walkable neighborhoods, particularly as researchers respond to calls for the scientific assessment of health and environmental claims.

This paper takes stock of this literature by linking together the various strands of research in which the "walkable neighborhood" is a primary concern.[2] Our broader interest is to better understand how a key government policy—the promotion of affordable housing in walkable neighborhoods—is supported by scholarship. The walkable neighborhood is now an explicit part of major federal programs (HOPE VI and Choice Neighborhoods), as well as new agencies (the Office of Sustainable Housing and Communities), and we want to assess how the walkable neighborhood as a policy goal is supported—or contested—by research. We hope to add some measure of clarity to a research landscape now crowded with competing claims about what the walkable neighborhood can be expected to do.

A major part of this task is to extract relevant research from the vast body of scholarship that exists on the more general topic of neighborhoods. A search on Google Scholar for journal articles with the word "neighborhood" in the title yields

[1] http://www.walkinginfo.org/; http://americawalks.org/resources/walking-facts/

[2] We use the term "walkability" to characterize geographical access as well as route quality. References to "walking" and "pedestrian" are meant to imply an associated neighborhood context.

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over 2.1 million entries. A search on "walkable neighborhood" returns over 500 entries, 96% of which were published since 2000. Many of these are included in our review.

The walkable neighborhood is a *physical* phenomenon—a bounded place in a given spatial location with selected material properties. It should not be confused with the idea of a "successful neighborhood," often defined by a more generalized ability to enhance the well-being of residents. Neither should the walkable neighborhood be conflated with "bricks and mortar" approaches to community development, where research focuses on housing stock renovation or commercial revitalization strategies in troubled neighborhoods. Not all instances of research on the physical qualities of neighborhoods touch on the issue of walkability.

Though the walkable neighborhood as a physical construct has been absorbed in a broad range of scholarly domains, research objectives vary widely. Some studies emphasize the management, organization, policy, and processes necessary for a walkable neighborhood, perhaps involving a neighborhood's ability to generate "community-relevant attitudes and behaviors" (Brower 2011). There are affirmations of the importance of the walkable neighborhood, methodological proposals for more successful implementation, and counter-responses highlighting the potential for adverse effects. In short, the walkable neighborhood is a tangible, definable, culturally significant phenomenon motivating scholarship in a wide variety of fields, and generating research results with cross-cutting applicability.

The paper is structured as follows: At first the meaning and implication of the walkable neighborhood is introduced and defined. Then literature is reviewed by organizing it into three broad categories, all of which have a bearing on policy goals related to affordability in the context of walkable neighborhoods. Firstly it had to be ascertained how the walkable neighborhood is measured? in this respect the methodological issues are reviewed and the degree to which walkable neighborhoods exist in the U.S is assessed. Secondly, the criticisms that have emerged regarding walkable neighborhoods is reviewed. Are walkable neighborhoods good for everyone? What evidence is there of unintended consequences? What are the downsides of pursuing walkability? What evidence is there that people prefer to live in walkable neighborhoods? Thirdly, the research focused on testing the main assertions of the walkable neighborhood is reviewed. The evidence on three common claims: that the walkable neighborhood promotes physical activity, and thereby improves health; that the walkable neighborhood is good economically; and that the walkable neighborhood is good for a variety of social reasons, is reviewed

Defining the Walkable Neighborhood

Much is implied by conjoining the terms "walkable" and "neighborhood." The phrase is both a verb connoting an activity (walking, experiencing) as well as a noun describing a kind of place. A concise definition of "walkable neighborhood" is that it is a safe, well-serviced neighborhood, imbued with qualities that make walking a positive experience. A "positive" walking experience means that streets, sidewalks and paths (pedestrian routes) are comfortable and interesting (see Speck 2012).

Embedded in the phrase "walkable neighborhood" are a range of cultural meanings and implications for everyday life (Demerath & Levinger 2003). Writers have been exploring these meanings for two centuries now, for example in the writings of Balzac and Baudelaire (Kramer & Short 2011), finding philosophical insight in the very act of walking, during which "the mind, the body, and the world are aligned, as though they were three characters finally in conversation together" (Solnit 2000: 5). The idea that a place (or neighborhood) should be "walkable" conjures up a pre-19th century, holistic view of health and well-being, combining notions of citizenship, civic life, democracy, resiliency, spiritual health, beauty, and social justice (see Kashef 2011).

The walkable neighborhood is interesting, too, in that it is a subject through which very divergent interests are connected—transportation planners, sustainability advocates, sociologists, urban designers, and those in the health and biological fields all have an interest. One line of inquiry might focus on the pedestrian, for example how they navigate urban space, or what their space requirements are (as analyzed in the classic study

Urban Space for Pedestrians by Pusharev & Zupan 1975). A related endeavor might involve an assessment of the effects of living in a walkable neighborhood, for example, on physical activity, body mass, obesity, or social interaction.

Even where researchers avoid using the term "walkable neighborhood", perhaps opting for the more generic "place quality", there is often an implied connection to walkability. For example, measures of "neighborhood quality" in social science research tend to be limited to census variables, but if access to services and facilities is considered important, then the neighborhood pedestrian environment is necessarily implicated. Place quality paired with considerations of access to jobs and services can scarcely avoid the walkability dimension. Research on community and economic development, worker and household mobility strategies, or the problem of service inequity can all have an implied connection to the issue of walkability in a neighborhood context.

Research on walkable neighborhoods often starts with an underlying normative idea about what a walkable neighborhood is, and proceeds to evaluate it: Is it good for everyone? Can it be implemented? Does it have positive effects? As a normative goal, the walkable neighborhood has the following characteristics: it has an urban form that encourages pedestrian activity and minimizes environmental degradation; it is associated with social, economic and land use diversity as opposed to homogeneity; it connects uses and functions; it has a quality public realm that provides opportunities for interaction and exchange; it offers equitable access to goods, services, and facilities and it protects environmental and human health.

From the urban planning and urban design literatures, there are normative accounts explaining why the walkable neighborhood is essential (for example, CNU, 2000). In the health field, the walkable neighborhood encapsulates the goal of the "Active Community" (Doyle et al., 2006), while from the sustainability literature, the walkable neighborhood is seen as a development form that can reduce the ecological footprint, minimize car travel, reduce energy consumption, and limit encroachment on open lands (Van der Ryn & Calthorpe 1986; Ewing et al. 2010). The energy benefits of walkable neighborhoods are believed to extend beyond "green building", as traveling to a building is said to account for twice as much energy as operating a building (Wilson & Navaro 2007).

In the housing policy literature, the walkable neighborhood is most often associated with social diversity, especially mixed income environments (Kingsley 2009). Some researchers have argued that access to public transportation and jobs, land use and housing stock variety, and proximity to downtown—physical characteristics often associated with walkable neighborhoods—are important for maintaining social diversity (Nyden, Maly, Lukehart, 1997; Nyden, 1998). According to Jane Jacobs (1961), variation in building type has the effect of increasing the diversity of both population and business enterprise.

Bolstering these affirmations of the benefits of walkable neighborhoods is a large literature examining the effects of environments that are the opposite – that is, places that are "low density, noncontiguous" and "automobile dependent" (Bengston, Fletcher & Nelson, 2004: 271). In some contexts, these non-walkable places have been shown to contribute to global warming (Gonzalez, 2009), social inequity (Squires, 2002; Pendall, 2000), environmental degradation (Benfield et al., 2001; Ewing, 2005), and public health problems (Frumkin, 2004).

The walkable neighborhood is also associated with specific design parameters. The quality of urban form at the block level is believed to affect the extent to which the built environment supports pedestrian activity. These considerations include whether there are street trees and wide sidewalks, whether blocks are faced with parking lots, blank walls, or glass-fronted shopfronts, or whether there is sufficient street connectivity and low traffic volume. In areas of high density and high ground coverage, neighborhoods relieved by frequent streets, created by small block size, are believed to be more walkable.

The population of a walkable neighborhood varies widely depending on spatial extent and density. Since a walkable neighborhood is by definition not automobile-dependent, a certain population density is implied – that is., a level needed to sustain pedestrian-based services within walking distance, or within walking distance of a transit stop. But these basic qualities can vary on a number of dimensions, especially size, regional location, level

of mix, and density. Walkable neighborhoods can exist in downtowns, or in places of less density, such as inner-ring suburban areas.

As a normative goal, the walkable neighborhood is often in the range of 5,000-10,000 residents (Alexander 1977: 71), but this depends on level of urban intensity (that is., whether the neighborhood is in a central urban core or in a less-dense suburban location). The early 20th century garden city of Letchworth, comprising several walkable neighborhoods, had a population of about 10,000. Clarence Perry's "neighborhood unit" was an idealized walkable neighborhood, and its population was 5,000 residents, although later application of the concept in the British new towns was based on a population of 10,000 (Goss 1961). New Urbanists today use the 5,000 – 10,000 range to define the optimal population for a walkable neighborhood or "urban village" (Krier 2008).

Apart from these normative and theoretical conceptions, the walkable neighborhood can also be determined empirically. Walk Score, a company devoted to the measurement of walkable access to amenities, has devised a scoring method (http://www.walkscore.com/) that uses business and amenity locations, street networks, and official neighborhood boundaries to assess the walkability of hundreds of neighborhoods in the U.S. Their most recent accounting of the 300 most walkable neighborhoods sheds light on the size and density of walkable neighborhoods in the U.S.

1. Measuring the Walkable Neighborhood

The walkable neighborhood has been translated into a variety of measurable characteristics for the purpose of facilitating empirical evaluation. These measures have expanded significantly in the past decade, largely in response to interest in connecting neighborhood design to travel behavior and health outcomes (Frank et al. 2010). An initial round of measures included playful concepts like the "popsicle test" (a neighborhood is walkable if an 8 year old can safely buy a popsicle by him/herself and return home before it melts), Portland's "20-minute neighborhood" (Larabee 2008), or the "Halloween test" (neighborhoods are walkable if they are good for trick-or-treating; Benfield 2012). A commonly accepted rule-of-thumb is that one's neighborhood could be considered walkable if services, facilities and amenities—what one needs for daily life—are within .25 to .5 miles of ones home. Different kinds of services and amenities might be weighted according to proximity and importance (grocery stores weighted more heavily, for example). Walk Score uses this approach, factoring in assumptions about pedestrian behavior. The rating scheme gives locations (amenities) within .25 miles of an origin a high score, but beyond that distance, a distance decay function is applied to adjust scoring. At the distance of one mile, amenities receive only 12% of the full score, with a cut-off of 1.5 miles.

These calculations are based on the idea that pedestrians walk approximately 3 miles per hour, which means they reach .25 miles in 5 minutes, and 1 mile in 20 minutes. A 30 minute walk, or 1.5 miles, is considered a "reasonable upper bound" for defining the maximum distance people are willing to walk (Walk Score 2011; Turner, Shunk and Hottenstein 1998), and thus the maximum size of a walkable neighborhood. These metrics, now commonly accepted in literature, are based on average walking speeds determined from travel surveys (Lee and Moudon 2006, Cerrin et al. 2006, Kockelman 1996, Iacono et al. 2010).

Always there are multiple trade-offs and limitations involved in the attempt to quantify neighborhood characteristics (Clifton et al. 2008). A recurrent issue is how to translate the quality of pedestrian routes into measures suitable for quantitative research (Forsyth et al. 2006). There has been some critique that distance-based measures such as Walkscore's are missing the design dimension in favor of crude measures based only on distance and destinations. Many argue that urban design factors, what some have termed "micro-scale elements" (Owens 1993: 115), are integral to the assessment of the walkable neighborhood. Quantitative measures tend to miss qualitative factors like sense of enclosure, liveliness, safety, litter, or biophilia. It is unclear, however, how problematic quantified measures actually are. For example, follow-up studies of the Walk Score approach have generally validated Walk Score as a useful proxy for walkability (Carr et al. 2010; Duncan et al. 2011), generating "robust and transferrable results" (Weinberger & Sweet 2011).

To address concerns, one approach is to employ a micro-scale evaluation approach such as the Irvine-Minnesota Inventory, which characterizes the quality of walkability and built environments using over 150 indicators that are generally collected through on-foot surveys of neighborhoods (Day et al. 2006; Alfonso 2005). There are experiments to automate this manual process of data collection using Google Earth or Streetview (Clarke et al. 2010; Rundle et al. 2011). Researchers have also used focus groups and surveys to find more appropriate assessment tools, investigating ways to quantitatively measure the "unmeasurable" (Ewing & Handy 2009). They have looked for ways to identify barriers to walking (Bejleri 2010), the special requirements of children on their way to school (Gallimore 2011), the "morphological and spatial structures" associated with walking (Kashef 2011: 39), or the degree of "friendliness" the environment exhibits toward physical activity (Brownson 2004). Researchers have began exploring the feasibility of mixed methods, incorporating both a field-based surveyor method as well as automated tools, arriving at "a new generation of environmental exposure measures" (Thornton et al. 2011: 1; Cerin 2006). One example involves combining ground-level audits of street segments with GIS data, merging reliability and quantification (Evenson et al. 2009).

In the sociological literature, neighborhood conditions have most often been measured on the basis of census variables such as poverty level, educational attainment, measures of crowding, or the identification of neighborhood "distress" (Kasarda 1993; Pendall 2000; Wood et al. 2008). However, interest in walkability and related dimensions of urban form has rendered census tract measurement rather limited. The only walking related measure in the U.S. Census is walking as a percent of workers aged 16 years and older who walk to work, and this data is only available by zip code. To overcome this limitation, sociologists have applied the principles of "ecometrics", the science of assessing environments through systematic observation (Gauvin et al. 2005; Raudenbush & Sampson 1999). In a similar vein, measures applicable to walkability might be drawn from neighborhood "audits," often employed in urban planning contexts (Clifton 2006).

Many articles have explored the degree to which perceived measures of the walkable neighborhood (via surveys of residents, for example) overlap with objective measures like audits and GIS data (Brownson et al., 2009; McCormack et al. 2008). Perceptions of neighborhood quality are not always in line with objective measures, and researchers have been interested in how this might impact outcomes like physical activity (Hoehner et al. 2005). Some have sought ways to leverage children's local knowledge to gain better insights about the relationship between perceived neighborhood environment and health (Wridt 2010).

Research that attempts to locate the correlates of walking, often for the purpose of evaluating health or transportation impacts, has been especially attuned to neighborhood measurement. In the health literature especially, this has involved separating "neighborhood environmental factors" like socio-economic status or presence of sub-standard housing, from "built environmental factors" like sidewalks, walking paths, and facilities like parks and playgrounds (Singh et al. 2010). Studies of the relationship between urban design and behavior (e.g., walking) show that scale effects need to be properly accounted for (Learnihan et al. 2011). In transportation research, the core variables of "destinations, distance, density, and route: the 3Ds + R" —and the addition of "diversity" (Ewing & Cervero 2010) —are screened, prioritized and modeled to find the correlates of walking (Lee & Moudon 2006). Maghelal & Capp (2011) identified 25 pedestrian indices whose variables could be classified into 10 different constructs, ranging from "pleasantness" to intersection counts. Attempts to "operationalize" the walkable neighborhood (Moundon et al. 2006), debating questions such as, whether pedestrian level of service should be emphasized above "safety in numbers" (Lo 2009: 145), are motivating the quest for even more measurement specificity.

Some research does not pinpoint the walkable neighborhood as a specific object of concern, but the measures employed could be used to identify variation in walkability. For example, a variety of measures have been employed to assess the degree to which neighborhoods are compact, have diverse uses and mixed housing types, or have well-designed public spaces (for example, Burton 2002;

Frey 1999; Mazmanian and Kraft 1999; Williams, Burton, and Jenks 2000; Clemente et al. 2005; Miles and Song 2009). In the sustainability literature, urban form is quantified by employing standardized measurement tools such as LEED-ND (Stangl & Guinn 2011), many of which could be used to assess walkable neighborhoods. While not specifically focused on walkability, these measures are meant to capture the qualitative differences of places in ways that largely define the separation between walkable and unwalkable places—differences related to segregated land uses, blocks sizes that identify superblock "projects," socially insular and physically disconnected housing, and car-dependent subdivisions and shopping malls.

How prevalent are walkable neighborhoods?

Inter-related to measurement methodology is the empirical question of the degree to which walkable neighborhoods actually exist. This question is only partially answered by statistics about walking behavior—that is., that today 13% of children walk to school, down from 66% in 1970 (see www.americawalks.org). The prevalence of the walkable *neighborhood* as a physical construct requires a separate kind of assessment.

The number of people now living in what could be considered a walkable neighborhood can be estimated using Walk Score's accounting method. For the 359 metropolitan areas in the U.S., which have a total population of about 256 million people, about 3.2% or roughly 8 million live in neighborhoods that would be considered very walkable (having a walkscore of 90 or better).

A related question involves assessing the degree to which one important component of the walkable neighborhood is present, or conversely, whether a condition that would impair walkability is in evidence. There are a host of facilities and services that are deemed essential for the walkable neighborhood, and thus research that investigates their presence or absence – their accessibility—is relevant. Lack of access to grocery stores and food (Beaulac, Kristjansson, and Cummins 2009), as well as insufficient child care facilities in neighborhoods that need them most (Galster 2010), are likely to have an effect on neighborhood walkability.

These questions put walkable neighborhood research in an environmental justice framework. For example, studies linking health and place have assessed variation in neighborhood attributes, finding, perhaps not surprisingly, that low-income neighborhoods "lack amenities and safety attributes that can facilitate high levels of physical activity" (Sallis et al. 2011). A study looking for the link between built environment and obesity revealed that disadvantaged groups lived in worse-off neighborhoods "with respect to food stores, places to exercise, aesthetic problems, and traffic or crime-related safety". In that study, the suggested strategy for reducing health disparities was to increase food access, safety, and places to exercise—all elements of the walkable neighborhood (Lovasi et al. 2009: 7).

Not all research on service accessibility, even when scaled to the neighborhood, is relevant to walkable neighborhoods. One issue is that facilities that might otherwise be viewed as neighborhood assets may not be viewed positively vis-à-vis walkability goals. For example, facilities thought to be important for neighborhood revitalization in a community development framework, such as hospitals (for example, Rutheiser 2011), might be interpreted more negatively in walkable neighborhood contexts if they are large and traffic-generating. Even so-called "placed-based" approaches to school quality often fail to address the full dimension of what is meant by the walkable neighborhood as a specific kind of physical environment.

For some types of services and facilities, the impact on walkability may be ambiguous. For example, it is unclear what effect the high density of fast-food outlets found in poor neighborhoods (Reidpath et al. 2002) has on pedestrian behavior. However, it would not be unreasonable to postulate that the presence of liquor stores and predatory lending institutions (Briggs 1997) work against the walkable neighborhood, perhaps by detracting from pedestrian safety or route quality. The discovery that playgrounds are often locked and inaccessible in poor neighborhoods (Scott et al. 2007) might have a similarly negative effect on walkability.

2. Criticism of the Walkable Neighborhood

To critics, the problem with the walkable neighborhood as a policy goal is that it is a

physical, deterministic solution that ignores people, institutions, and political processes. While there is growing interest in the importance of walkability, many are cautious that gains are limited, and that the benefits of the walkable neighborhood are conditional on some other factor that is insufficiently controlled. For example, Brower (2011: 119) argued that compact and walkable neighborhood design intended to encourage social interaction might only be beneficial if other "community-generating properties" such as "like-minded residents" or organizational support are also in place. Some have wondered if the more important question is whether monetary costs outweigh benefits when it comes to policies that promote walkable neighborhoods (Boarnet et al. 2008).

Mixed income, fair share, and housing mobility programs have not traditionally engaged the issue of walkability in an explicit way. As a result, the question of whether a neighborhood is pedestrian-friendly is still considered tangential to the traditional purview of housing policy analysis, and some have challenged whether affordable housing in the walkable neighborhood is necessarily more important than affordable housing in other contexts (Pendall & Parilla, 2011). Neighborhoods might be walkable in terms of physical metrics like small block size and land use diversity (Lee 2007) but they might underperform on other dimensions, like school quality and crime (Pendall & Parilla, 2011; Been et al., 2010). The complication is that not all factors comprising the walkable neighborhood may align – neighborhoods might be mixed use but high crime, they might be mixed in income but have low access, or they might have walkable urban form with no diversity of land use (Talen and Koschinsky, 2011).

Defining walkability for a variety of social contexts is a significant challenge. While many agree that mixed uses –including public and quasi-public facilities and neighborhood-level comercial enterprises– are essential for the walkable neighborhood in general terms (Boarnet & Sarmiento 1998; Smith et al. 2008), finding the appropriate mix to support a diverse group of people can be problematic. As Goetz (1996) cautioned, "the poor relate to [neighborhood] amenities in ways fundamentally different from more affluent families." For example, public transportation and affordable daycare are likely to be much more important to poor families (see also Bayer, 2000). Debate over the wisdom of dispersing subsidized housing ties into this land use mix issue.

The benefits obtained from living in a walkable neighborhood- or at least, a partially realized version of the walkable neighborhood – are conditional on other factors. This is most evident in poor neighborhoods. There, density and land use mix might be offset by poor design and safety concerns (Neckerman et al 2009; Doyle et al., 2006). The relationship between walkable neighborhoods and health may not hold in more disadvantaged areas, in part due to conditions like lack of greenery, social networks, or higher traffic load (Cerin et al., 2009; Timperio et al. 2005).

Some researchers have found that there are socio-economic differences in the degree to which people engage in walking for transport, which in turn limits the health benefits of living in a walkable neighborhood (Frank et al. 2008), although another study showed that the physical activity benefits of living in high walkable neighborhoods "did not differ by neighborhood income" (Sallis et al. 2009). In one survey, respondents in lower socio-economic (SES) areas had superior access to recreational facilities (which may be associated with the walkable neighbor-rhood), but were less likely to use them compared to respondents living in higher SES areas (Giles-Corti and Donovan 2002). Another finding is that the relationship between walkable neighborhoods and walking may only hold for some measures in non-white households. For example, Kerr et al. (2007) found that five dimensions of good urban form impacted walking for white households, but only two dimensions – land use mix and access to recreational space – were associated with walking among non-white households. There are gender differences as well. Girls living in walkable neighborhoods have been shown to have lower odds for obesity, but this finding did not hold for boys (Spence et al. 2008).

Perception of neighborhood factors might be as important as objective measures in terms of explaining the impact on physical activity, and this finding could be used to argue against the value of absolute definitions of walkability. For example, perception of neighborhood quality has been found

to be important in studies linking neighborhood form to walking behavior (Ding & Gebel 2012). Research might target the perceptions of specific populations (for example, youth) in specific types of environments (for example, schools; see Fein et al., 2004), and show how perceptions affect some types of physical activities but not others (Humpel et al. 2004). Correlates might also be gender-specific. One study of children walking to school found that perceptions about neighborhood environment were especially predictive for girls' walking (Hume et al. 2007).

A different line of criticism positions the walkable neighborhood as a complicit part of unjust neoliberal policies aimed at displacing the poor. This view challenges walkability as a policy goal by way of mixed-income housing policies, which are associated with the walkable neighborhood. It has been argued that mixed-income, walkable neighborhoods have not garnered substantial benefits for low-income residents (Joseph et al., 2007; Fraser and Kick, 2007). Walkable neighborhoods have been pejoratively described as "Starbucks-fringed mixed-income communities with vaguely pastoral names like North Town Village, Mohawk North and Parkside of Old Town" (Vale, 2012) not because of their walkability per se, but because their walkability is associated with developer-driven policies that neglect the needs of low-income groups.

Critics in this vein are reluctant to prioritize design features known to promote walkability. For example, Vale recounts two phases of housing transformation in Chicago, one a modernist (largely unwalkable) vision in the 1950s, the other a (largely walkable) New Urbanist vision in the 1990s. Vale observes that "the row houses enjoyed relative and prolonged success, while the high-rises were challenged almost from the start" (Vale 2012), but both are denounced as "large-scale social engineering." The fact that one form is more likely than the other to be associated with walkability is obscured by larger issues of "emplacement, replacement, and displacement" that are believed to plague public housing strategies in any form.

The implementation of policies aimed at promoting walkable neighborhoods always involves trade-offs, and often partial success comes with costs. Some scholars have argued that although higher density "sustainable" neighborhoods may have greater equity in terms of access to resources, compact urban form is a problem that can "worsen neighborhood problems and dissatisfaction" (Bramley & Power 2009: 46). Other researchers have questioned the value of intensifying parts of a city to make it more sustainable (that is, walkable), asking: "if this results in diminished opportunities for lower-income groups to live in the central city, is such intensification necessary or sufficient as a basis for social sustainability with respect to planning for housing?" (Ancell and Thompson-Fawcett 2005: 427).

These concerns, which are essentially about gentrification and displacement, are problems that are often associated with the walkable neighborhood. By strict definition, the walkable neighborhood is socially mixed, but it is often under threat of losing that diversity due to gentrification pressures. Thus, great design in the form of a walkable neighborhood fuels not only economic growth, but also "market forces that accelerate speculation, increase property values, raise taxes and rents, and ultimately – perversely – drive many residents out of the area" (Davis, 1984/2010: 372). Studies have documented that gentrification is more likely to occur in high density neighborhoods where "proximity-related benefits" increasingly enter "people's utility functions" (Pendall and Caruthers 2003: 547). Research funded by the U.S. Department of Transportation found that many walkable developments –especially those located near transit stops– are becoming increasingly unaffordable (USDOT, 2008; see also Pollack et al., 2010). As higher-income groups move "back to the city" because they value walking and access to amenities (Hughes and Seneca, 2004), enclaves with limited social mix often result. Strategies have been proposed that would be capable of reversing the negative effects, that is, displacement and loss of affordability, especially where investments have been made to stimulate walkable neighborhood development (Chapple 2009; Harrell 2009; Haughey 2010; Quigley 2010).

Working against the idea that the walkable neighborhood should be a key policy goal is the finding that low-density, unwalkable development increases housing choices for a wider range of socioeconomic groups (Glaeser & Vigdor, 2003).

Some have argued that low density (unwalkable) areas are more socially diverse than the compact city in some cases (Pendall and Carruthers, 2003). These findings have to be reconciled with the likelihood that neighborhoods that are not walkable (i.e., low density) pose a significant problem for low-income people when it comes to the provision of neighborhood-level facilities and access to jobs and urban services (Talen & Koschinsky 2011).

Finally, there is the critique that walkable neighborhoods should not be a goal because people – specifically, Americans – don't want to live in them. While there are aspects of the walkable neighborhood that consistently resonate with the American public – schools and safety, for example (Weiss 2004) – preference surveys have often shown that Americans prefer single-family detached housing and greenery (Audirac, 1999), such that density and satisfaction appear to be inversely correlated (see, for example, Marans & Rodgers, 1973). This is a problem for walkable neighborhood proponents to the extent that density and walkability are correlated, which is not a straightforward relationship.

With changing demographics, some have argued that these historical preference structures are evolving (Myers 2007), as many residents who prefer low density "could do well without the rest of the suburban package" (Ewing, 1997; see also Levine & Frank 2007; Leinberger 2007; Nelson 2013). It is likely that there will continue to be a kind of cognitive dissonance between the desire for walkability and the perceived tensions resulting from living in the kind of heterogenous, high density environment that the walkable neighborhood implies (Brower 2011; see also Gans 1961 and Rapoport 1980/81).

3. Testing Assertions about the Walkable Neighborhood

Various claims have been made about the benefits of walkable neighborhoods. In this section, we review the literature on three of the most prevalent (and well researched) claims: that walkable neighborhoods have a positive impact on a) physical activity and health; b) economic value; and c) social connection.

The notion that the walkable neighborhood promotes physical activity, and therefore health, has generated a vast literature exploring and testing the relationship. Walking has been the main object of study since it is believed to be a key mechanism through which health is improved, and because walking appears to be more sensitive to neighborhood design than driving (Shay & Khattak 2007). Health is assessed by looking at body mass index (BMI), physical activity, or travel behavior – that is, walking and transit use vs. car use.

More than 200 research articles have been published on the question of tying neighborhood form to physical activity (for recent reviews, see Feng et al. 2010; Foster and Giles-Corti 2008; Lachowycz and Jones 2011). Most studies do find important relationships between physical form and walking, physical activity, and ultimately, obesity and other health measures (Saelens & Handy 2008). Surveys of the literature have found consistency between "smart growth urban planning" – that is, walkable neighborhoods – and physical activity, particularly the dimensions of "diverse housing types, mixed land use, housing density, compact development patterns and levels of open space" (Durand et al. 2011: 173).

Conventional wisdom has now coalesced around the notion that neighborhood context effects exercise, even "independent of an individual's background" (Wen & Zhang 2009: 247). In a typical example, one study found that "household heads of single-family dwellings" in a new urbanist neighbourhood had lower BMI due, in part, to "utilitarian trips made by walking or bicycling" (Brown et al., 2008, p. 963). Another study compared a walkable neighborhood with a conventional suburb to find higher physical activity in the former (Rodriguez et al. 2006). Brian Saelens and James Sallis have authored multiple studies showing the neighborhood-based differences of physical activity (Saelens et al. 2003; Sallis et al. 2002).

Research in the transportation field tests whether walkable neighborhood form actually increases walking and reduces car-based trips. This assertion has mostly been upheld, often, with the acknowledgement that walking is likely to be "achieved more rapidly" among residents who value walking in the first place (for example, Lund 2003: 428). Unraveling causality and accounting

for the issue of self-selection bias is an ongoing concern (Eid et al. 2008), but the importance of the built environment remains strong even when self-selection is controlled by factoring in socio-demographics, personal preferences, auto ownership, or safety perceptions (Cao et al., 2007; Handy et al. 2005). Proximity to workplace has been found to be a strong predictor of transport-related walking, especially for women (Cerin et al., 2007). In addition, walking for transportation, as opposed to leisure, has been shown to be correlated with almost all dimensions of the walkable neighborhood among young people (Shigematsu et al. 2009).

It is possible to break down the basic relationship between walkable neighborhoods and health in numerous ways. The object of inquiry might be separated out into transport-related physical activity as opposed to recreational walking (Badland et al. 2008; Besser & Dannenberg 2005). Particular pieces of the walkable neighborhood may be broken out, for example looking at the correlation between walking and access to "attractive" open space (Giles-Corti et al. 2005: 169). One study found that neighborhood characteristics impacted strolling, while commercial area design impacted shopping trips (Cao et al., 2006). Population subgroups may be studied, for example, seniors (Cunningham & Michael, 2004), children (Dunton et al., 2009), or the disabled (Clarke et al., 2008). Essentially, different types of environments affect different kinds of people walking to different kinds of destinations. As one study put it, "the environment is differentially related to walking" (Bergman et al., 2009).

While the vast majority of research has supported the connection between walkable neighborhoods and health, some studies have shown opposite trends, with one review of the literature arguing that there were "few consistent findings" (Dunton et al. 2009: 393). A recent longitudinal study comparing low-income African-American women in two contexts, one walkable and one less so, found that neighborhood features like sidewalks and front porches did not affect walking, but street patterns did. In another study, neighborhoods with more land-use mix were found to result in less walking (Wells et al. 2008). These inconsistent findings are likely the result of measurement variation. A recent "review of reviews" of the literature linking built environment to physical activity argued that there is a need for more sophisticated statistical models, better measurement specificity, better definitions of neighborhood and place, and more "mediators and moderators" (Ding and Gebel 2012).

A second assertion, outside of the transportation/physical activity/health domain, is that walkable neighborhoods offer substantial economic benefits (Leinberger 2007). This is often assessed by studying the effect of walkability on property value. A recent study regressing property value on correlates of the walkable neighborhood found that density, mix and "pedestrian infrastructure" contributed to higher property values (Sohn et al. 2012). Another study claimed that a one point increase in Walk Score translated to a $3,000 increase in property value (Cortright 2009).

Some studies of walkable neighborhoods have shown that, despite having smaller sized and more diverse housing units, walkable neighborhoods appreciate in value – and lose affordability – faster than conventional housing developments. One study of housing prices in New Urbanist development (a development type associated with walkability) found that most projects were able to price units above market rates (Eppli & Tu , 1999). Subsequent research has supported the view that New Urbanist development has been able to command a higher price in the market place (Tu and Eppli, 2001). Song and Knaap's 2003 study of housing values found that a net 18% premium was paid for design amenities like pedestrian quality and walkable access.

Another way to gauge economic value is to assess the effect of the walkable neighborhood on personal wealth or income. Groups like the Center for Neighborhood Technology (CNT) and the Natural Resource Defense Council (NRDC) have done the most to advance the notion that affordability is a measure of location as well as housing unit, summarized by the term "location efficiency". This logic is behind location-efficient financing of mortgages, where residents are permitted to leverage transport cost savings to access cheaper or larger loans (Brookings Institute, 2006; Center for Neighborhood Technology, 2008). A related finding is that foreclosure risk is

higher for households with more cars, in turn related to neighborhoods with poor access to public transportation (Rauterkus et al. 2010). The reduction of costs in a walkable neighborhood can be extended to other dimensions; for example, if the neighborhood is also able to incorporate green areas for local food production, this may constitute further savings for the household by way of providing cheaper food (Mouzon, 2006).

Another approach is to evaluate the economic impact of particular aspects of the walkable neighborhood, such as facilities, mixed use or mixed housing type. For example, goods schools have been shown to increase housing value (Kane et al. 2003), and it could be argued that the school-centric focus of the walkable neighborhood is likely to reap similar gains. On the issue of mixed housing, one question is whether neighborhoods are affected negatively by housing type mix, especially if the mix includes subsidized housing. Research has shown that this assessment relies heavily on neighborhood context (Tatian et al. 2012). If subsidized housing is overly concentrated and located in struggling neighborhoods, the effects might be negative, but in other locations, or combined with other strategies, housing mix can have a positive effect on housing value (Ellen & Voicu 2005). Walkability is likely to be an important part of defining what this positive context consists of.

Finally, a large literature extending back to the 1950s has tried to test the association between built form and social goals (Talen 1999), a subset of which has narrowed in on the community claims of the walkable neighborhood. Robert Putnam's work motivated the latest wave of researchers interested in the association between neighborhood form and social capital (Putnam 2007). Surveys have utilized Putnam's scale measuring social capital to show the link between the walkable neighborhoods and "higher levels of social capital such as trust among neighbors and participation in community events" (Rogers et al. 2010).

The walkable neighborhood has been shown to be associated with trust and social engagement (Leyden 2003) as well as sociability (Brown & Cropper 2001). Researchers have argued that beyond environmental and health benefits, the walkable neighborhood facilitates "the generation and maintenance of social capital," an important determinant of "quality of life" (Rogers et al. 2011: 201). Social benefits might involve, first, resident interaction and neighboring, in turn leading to social connection, sense of community or collective efficacy.

Studies often compare two areas, for example a walkable (New Urbanist) neighborhood compared to a suburban, auto-dependent one nearby. Researchers have found higher rates of social interaction, "substantially greater sense of community", and stronger place attachment in walkable neighborhoods (Kim & Kaplan 2004: 313). Podobnik's comparison found increased social interaction in a new urbanist neighborhood (Podobnik 2011). A well-designed public space, a key component of the walkable neighborhood, has been shown to encourage social interaction, especially in mixed-income areas (Robert 2007). Neighborhoods designed to be "safe and social," incorporating frequent destinations associated with walkability, have been shown to improve both social capital and feelings of safety (Wood et al. 2008).

The issue with these kinds of studies is the problem of self-selection bias. The walkable neighborhood may simply be attracting residents with similar interests and characteristics, and this homogeneity may increase resident interaction (Keane, 1991; Plas and Lewis, 1996). Although there are consistent findings that the walkable neighborhood is capable of influencing neighboring and local social ties in a positive way (Lund 2003), self-selection also likely determines the type of social interaction affected – for example, the neighborhood might correlate with "unplanned interactions" but not "supportive acts of neighboring" (Lund 2003: 426). In addition, linkages between the walkable neighborhood and civic engagement might not hold in countries outside of the U.S. A recent study in the U.K. comparing different types of neighborhoods – walkable and otherwise – found no association between design and civic engagement (Mason & Fredericksen 2009).

Our findings can be summarized as follows. Research over the past decade has revealed that a low percentage of people in the U.S. (below 10%) live in walkable neighborhoods. Innovative technologies and new data sources have stimulated research on measuring walkability, and these

measures are becoming increasingly sophisticated and fine-grained. Using these new measurement tools, on the question of why people walk? Research has uncovered commonsense correlates, such as, proximity to useful destinations, safety, and route quality. These relationships become more complex when the socio-economic characteristics of individuals are taken into account, such that factors important in some contexts (such as density and land use mix) may not hold in more disadvantaged areas. In terms of effects, walkable neighborhoods have been shown to have a positive impact on physical activity and health, economic value, and social connection, although the latter is only weakly supported because of the problem of self-selection bias.

Two research findings seem to work against the idea of the walkable neighborhood: walkable neighborhoods are likely to boost gentrification and displacement, and that there may be potential for walkability to distract attention from more pressing issues like poverty concentration and resource equity. Weighing these factors, the overall policy implications of research on walkable neighborhoods can be summarized as follows: walkable neighborhoods have significant and proven benefits and thus policymakers should support them; walkable neighborhoods have the potential to stimulate unintended consequences such as gentrification and displacement; and the elements that support walkable neighborhoods require sensitivity to socio-economic context, such that the design correlates of walkability do not transfer equally to all neighborhoods. Policy-makers can support walkable neighborhoods while remaining sensitive to these potential problems, tailoring strategies to specific kinds of neighbor-hood conditions.

Conclusion

The walkable neighborhood has taken on a special significance in recent years, paralleling a surge of interest in sustainability and forming an essential basis for pursuing environmental, economic, social, and health objectives. The walkable neighborhood has garnered a substantial scholarly interest, as researchers have endeavored to test the many associated claims. Reviewing hundreds of research articles on walkable neighborhoods, we summarized the research in three domains: measurement, criticism, and the testing of assumptions. Our interest in presenting this review was motivated not only by the significant scholarly output and methodological advances, but the parallel growth in federal programs and funding opportunities that make the walkable neighborhood an explicit policy objective.

We were also drawn to the topic because of its multi-disciplinary focus, through which it has the potential to integrate a diverse number of fields. This diversity has grown as many fields that do not traditionally engage with walkable neighborhoods as a primary object of concern nevertheless have an implicit walkability connection. For example, research on compaction, diversity, mixed use, and even public space may have a bearing on the quality of neighborhood walkability. Community and economic development issues, worker mobility strategies, the reduction of service inequities, environmental justice, and “place quality” are also examples of topics that have an intrinsic connection that may not be immediately recognized or valued. We believe these connections could be made more explicit. While there is recognition that neighborhoods must be safe and have good access to schools, employment and other services, there is often less recognition that something as mundane and basic as walkability needs to factor in.

The main conclusions of our review can be summarized as follows. Firstly, measures of walkability have improved substantially over the past decade, motivated by two events: government programs and funding sources – especially in the health and transportation fields – that are looking for verification of the claims of walkable neighborhood proponents and secondly, by substantial improvements in digital data sources, such as Walk Score. Progress is being made in combining audits of on-the-ground pedestrian experience with automated, GIS-based quanti-fication in order to insure that measures of the walkable neighborhood are more realistic.

Second, criticism of the walkable neighborhood has recently emerged. It is difficult to separate criticisms of the failure to achieve the true walkable neighborhood – that is, one that is by definition inclusive and diverse – and criticism aimed at any proposal that prioritizes the built

environment over process or serviceability. A significant complication revealed in the research on walkable neighborhoods is that the partial realization of walkable neighborhoods can be problematic. An obvious example is that if neighborhoods have short blocks with wide sidewalks but also have high crime, then their walkability is greatly compromised.

Often the source of criticism of the walkable neighborhood comes from those who see it as distracting from more urgent needs, especially affordable housing. Among affordable housing proponents, there is an interest in good planning, but the focus is often on permanent affordability, not whether a community is walkable and well designed. Proponents of walkable neighborhoods, on the other hand, are often not particularly engaged with affordability in a programmatic way. Walkable neighborhood proponents need to continue to make the case that affordability is directly impacted by the physical design of neighborhoods, but at the same time, they need to be prepared to address the very real problem that walkable neighborhoods, in imperfect form, exclude low-income people. Ideally, affordable housing advocates and walkable neighborhood proponents would be able to see the natural overlap of their objectives and work toward common goals.

Third, the testing of assumptions has mostly supported the claims made by walkable neighborhood proponents. Walkable neighborhoods have been shown to increase walking, physical activity and health, increase property value and the value of place more generally, and there seems to be some association with social goals like interaction. Of the three primary claims, the social interaction and sense of community claims are the weakest, in part because there continues to be the problem of self-selection and the inability to assign causality.

It is interesting how much research now revolves around a seemingly simple goal: promoting the ability of everyone to live in a walkable place. Past proposals, from Garden Cities to Urban Renewal, were not subjected to the level of measurement or outcomes research that the walkable neighborhood currently is experiencing. The focus on assessing the claims and assumptions, the pros and cons, and the unintended effects of the walkable neighborhood is testament to the new level of rigor proposals about the built environment are now subjected to. We see this as a positive gain, but wonder whether there will be a time, perhaps in the not too distant future, when research will move beyond assessment of impacts and move toward the subject of implementation. There is still much that researchers will be called upon to assess: How can we promote walkability in ways that minimize negative effects? And if the benefits obtained from living in a walkable neighborhood are conditional on other factors, how can we ensure that these conditions are in place?

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