Green Walking

Artful Technologies for Natural Connection

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ABSTRACT

The *Green Walks* project, funded by the Economic and Social Research Council and US National Academy of Medicine, aimed to encourage people to engage with green spaces for improved mental health. Initially, it focused on developing a tool to help people find green spaces within walking distance. However, through the development of a Green View Index in Cambridge, UK, the project found that the main barrier wasn't distance but rather a lack of awareness of the green spaces that already existed. The project's focus has since shifted to help people recognize the "green" surrounding them, even in urban environments, through photographic practices, artful interaction, and community engagement.

INTRODUCTION TO THE HEALTHY LONGEVITY GLOBAL GRAND CHALLENGE

Through the Healthy Ageing Catalyst Awards, the UK Economic and Social Research Council (ESRC) has partnered with the venture capital firm Zinc to fund entrepreneurial academics who want to translate their research into impactful and scalable products, services, and interventions.

The awards are part of the United Kingdom Research and Innovation (UKRI) Healthy Ageing Challenge and the Healthy Longevity Global Grand Challenge, founded by the US National Academy of Medicine (NAM) [1]. This is a worldwide movement to improve physical, mental, and social well-being for people as they age. The Catalyst Awards are designed to create impact beyond academic research by funding early-stage, high-risk research-based ideas and innovations with the potential to transform our lives as we age.

Healthy longevity means maintaining physical, mental, and social health and well-being as we live longer. By extending the health span, people can stay active in their families and communities, remain in the workforce and contribute to the economy, and enjoy fulfilling and productive lives well into their later years.

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The Healthy Longevity Global Grand Challenge is based on recommendations from NAM's Global Roadmap for Healthy Longevity [2], which states that by 2030, the old will begin to outnumber the young for the first time in recorded history. This demographic shift poses significant social, economic, and health challenges but also presents an unprecedented opportunity for accelerating research, innovation, and entrepreneurialism in the field of healthy longevity—thereby building more vibrant societies and economies worldwide.

UK-SPECIFIC CHALLENGES HIGHLIGHTED DURING THE COVID-19 LOCKDOWNS

On 23 March 2020, the English Prime Minister, Boris Johnson, announced the start of a nationwide lockdown. All nonessential shops and services were ordered to close, and police were granted powers to issue fines, arrest people or send them home, and break up gatherings of more than two people. The UK population was instructed to stay in their homes, except when exercising once a day, for no more than one hour, shopping for essential items, medical needs, providing care to a vulnerable person, or traveling to work where the work in question was vital and could not be done from home [3].

Even before the COVID lockdowns, it was clear that a mental health emergency was developing in the UK. In 2016, a mental health task force set up by the UK's National Health Service (NHS) shared data showing that as many as 40% of primary care appointments were about mental health. In 2018, the UK mental health charity *Mind* stated that the NHS estimates three-quarters of people with mental health problems receive no support at all [4]. Reports from the King's Fund, Deloitte, and the Organisation for Economic Co-operation and Development (OECD) variously stated that treating poor mental health costs the NHS £11 billion, £45 billion, or £94 billion [5–7]. A follow-on report in 2022 by the Mental Health Foundation and the London School of Economics and Political Science states that "Mental health problems cost the UK economy at least £117.9 billion every year" [8].

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In a curious twist, at the start of the lockdowns, Public Health England was in the process of releasing the results and strategies on the value of providing access to green spaces as part of a consultation with Natural England, Sport England, The Parks Alliance, and local councils. In March 2020, they released "Improving Access to Greenspace: A New Review for 2020" [9], which details the benefits of access to greenspace and deeply entrenched disparities in access to green spaces resulting from major social inequalities. The report states that a majority of the population over 64 and/or from nonwhite backgrounds do not believe they have local green spaces within easy walking distance; that 2.5 million people in England live more than 10 minutes' walk from greenspace, and that many of these people found it was too expensive or took too much time to get to green spaces.

These inequalities and disparities in access to greenspace have been further highlighted through the Green Social Prescribing pilot programs launched in October 2020, while the UK was entering its second lockdown. Green social prescribing (also called nature social prescribing) is a practice connecting people with nature-based interventions and activities to improve their mental and physical health [10,11]. The £5.77 million NHS England Green Social Prescribing program was designed to test how to embed green social prescribing in mental health pathways. The program included financial resources and national program support for seven test-and-learn sites. Interim evaluations of the program, which focused on sites in areas disproportionately affected by COVID-19 and communities experiencing health inequalities, showed positive improvements in mental health and well-being and strong community engagement.

Evidence from the pilots suggests that people referred to social prescribing report that they value green and blue spaces and understand their benefits, but feel there are multiple barriers preventing individuals from engaging with green social prescribing opportunities, including:

- Physical barriers: Lack of proximity to quality greenspace, limited transportation options, and lack of facilities.
- Social and cultural barriers: Discomfort in a natural setting due to cultural experiences or racism.
- Perceptions, awareness, and interest: Concerns about safety and lack of awareness of opportunities.

The program team designed the Green Walks project to address these barriers and offer solutions for bringing these populations into green spaces.

GREEN WALKING AIMS AND OBJECTIVES

The core aim of the Green Walks project was to amplify the emergent NHS Green Social Prescribing pilots, and to codevelop tools in parallel with the launch of this national program. The initial project plans were developed in partnership with the Norfolk and Waveney Mind Nature Connect program, as well as Social Prescribing Link Workers from the Swaffham & Downham Primary Care Network [12,13].

The Green Walks project was initially envisioned as a tool for green social prescribing link workers to enable them to find engaging walks from anybody's front door, as well as providing a tool for appropriate monitoring and support. Interviews with link workers in the pilot green social prescribing scheme overwhelmingly demonstrated demand for customized access to green spaces; however, their time was too limited for them to create bespoke individual walks for each person in their care. Green Walks aimed to help the UK population in finding green spaces within easy walking distance of their homes, signposting environmental changes (such as flowers coming into bloom or local events) as an incentive to get out of the house and accompany care users on their walks.

Development of the Green Walks project was divided into two connected packages that (a) guided users to green spaces within walking distance of their front door and (b) encouraged older users to continue venturing outside despite the challenges older age presents. More specifically, the project pursued the following objectives:

A1: Generate a green-view database of an urban center by extracting images from existing mapping platforms to calculate the amount of visible greenspace along roads.
A2: Develop a mapping system to generate circular walks of 10, 20, and 30 minutes from any starting point within the database. These walks will be optimized to take in the largest amount of greenspace possible.
B1: Develop a website collecting observations from walks in Norfolk. These raw observations were to be refined into a Creative Commons collection of things to look for, listen to, and smell at particular times of the year.

GREEN WALKING METHODS

The green-view database and mapping system was built upon research conducted by MIT's Senseable City Lab [14], which used image processing and analysis tools to extract images from Google Street Maps and calculate the amount of visible greenspace along roads. One of the most promising data sources for capturing novel greenspace measures is the publicly available georeferenced images provided by Google Street View (GSV). When paired with AI-assisted image processing, this imagery presents significant potential for extracting features of interest, including the amount and composition of visible greenspace.

In 2015, Xiaojiang Li and colleagues processed GSV images to map relative levels of visible greenspace, or a green view index (GVI), across downtown New York City. More recently, Li and associates utilized GSV images to create city-block-level estimates of greenspace and identify associations between levels of greenspace and socioeconomic status. MIT's Senseable Cities Lab built upon this research to analyze the number of trees in 22 global cities [15,16]. The resulting maps can be found on their Treepedia website, with links to a GitHub site containing the Python code and Open Street Map data used to generate them. The first



Fig. 1 Treepedia's Green View Index map of London. (© Kirk Woolford)



Fig. 2 Detail of Treepedia's East London GVI map of one of the UK's least green locations. (© Kirk Woolford)

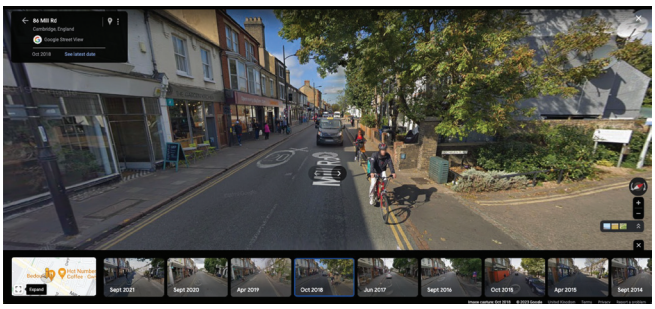

Fig. 3 Google Street View capture dates for Mill Road, Cambridge. (© Kirk Woolford)



Fig. 4. Google Street View of the same location in October 2018 (top) and April 2019 (below). (© Kirk Woolford)

step in the Green Walks development required updating code from Python 2.7 to 3.11 and corresponding versions of Pyshiftmean, Numpy, GDAL, PIL, Shapely, Fiona, and xmltodict.

Figure 1 shows the Treepedia map of the center of London, UK, an area widely considered to be a concrete jungle outside of the formal parks. Indeed, the Treepedia mapping shows London, with a 12.9% green view index, above only Kobe, Japan, with a GVI of 9.4%, and São Paulo at 11.7%. This contrasts with New York at 13.5%, Los Angeles at 15.2%, Amsterdam at 20.6%, Durban at 23.7%, and Vancouver at 25.9%. All the same, the map of London still shows distinct, green-lined walkways as detailed in Fig. 2. Green Walks originally aimed to guide users along these walkways to provide them access to green spaces directly from their front doors rather than requiring them to walk to a park.

Once the Treepedia software was running, the Green Walks team attempted to generate a green view map of the City of Cambridge, UK, but immediately ran into an unexpected issue. As detailed in Fig. 3, Google does not send its Street Map capture vehicles regularly every year. At the point Green Walks was in development, Street View data for the Cambridge test region was available for September 2021, but by this point, much of the vegetation had lost its green intensity, with many leaves fallen or browning. Figure 3 also demonstrates how the original Treepedia Green View Index algorithm would return very different results if run on Google's April 2019 Street View versus September 2021 data.

Because the Google Street Map data is refreshed at irregular intervals, the team developed custom software to sample 360° video from an Insta360 One X2 camera on a daily commute from Cambridge Station. Figure 4 shows the result of a local walk, calculating a GVI every 100 meters. Still photographs were also taken during the mapping test to verify the amount and types of vegetation encountered along this route.

ANALYSIS AND NEED FOR ARTFUL CONNECTIONS

The construction of the Cambridge GVI map led to a very unexpected outcome. Figure 5 shows a view of Mill Road, Cambridge. The Green View Calculation shows very little vegetation on this section of road, as evidenced by the view in Fig. 6.

However, as Fig. 7 shows, there is an abundance of vegetation shielded from the road yet visible from the sidewalk. In late June, not only are protected front gardens in full bloom as in Fig. 7, but Fig. 8 shows some of the "urban plants" growing wild throughout the crevices in walls and sidewalks.

When the researchers stopped mathematically calculating Green View Indices based on trees and shrubs as seen from the road and instead explored the road as photographers and artists, the number of plants in full bloom became evident. These were logged over one week in June 2022, in Fig. 8. Many of these plants were discounted by the Green View calculations due to the reds, oranges, yellows, violets, and myriad other bloom colors. The researchers found themselves slowing their commutes and walking further, but in a less stressed manner as they began observing the cycles

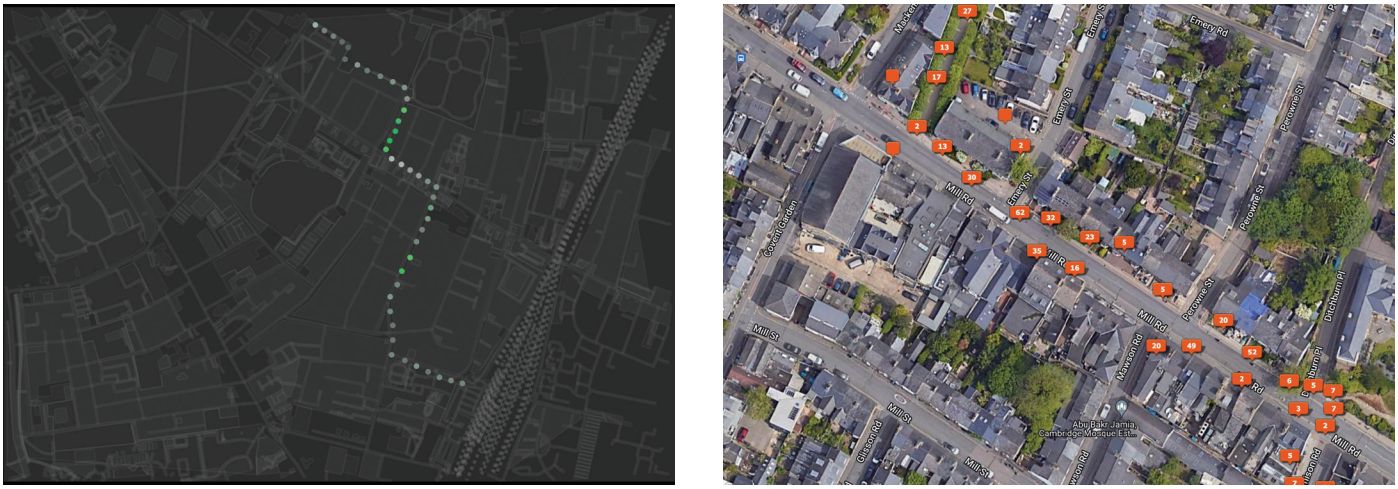

Fig. 5 Green View Index of Mill Rd, Cambridge showing apparent low Green View Indices (circled in red) with plants in full bloom (right) which are not automatically calculated as "Green" because they are colored red, orange, and blue. (© Kirk Woolford)



Fig. 6 Mill Road, Cambridge: very little green visible from street view. (Photo © Kirk Woolford)



Fig. 7 Mill Road, Cambridge: many wild patches and gardens hidden from street view but apparent from the sidewalks. (Photo © Kirk Woolford)



Fig. 8 Urban plants growing wild through cracks in the sidewalk and crevices in walls. (Photo © Kirk Woolford)

of blooms. They also started exploring the use of Apple's plant identification AI, built into iOS to identify unknown plants, and began walking the paths even when they weren't commuting.

CONCLUSIONS

Developing a Green View Index for the City of Cambridge highlighted assumptions made in prior calculations of Green View Indices. Namely:

- Google Street View data is collected at irregular intervals, making it impossible to compare vegetation on the same day, or even the same season, across different cities.
- The concept of "green" as living vegetation does not directly correspond with the definition of green as a color. Not all living, blooming plants reflect light in the 500–565 nanometer (nm) range.

Guiding people through the use of Green View Indices proved ineffective. However, developing a GVI map demonstrated that the Green Walks project was attempting to solve the wrong problem. The original data from the National Health Service indicated that the physical distance needed to travel to these spaces is a primary barrier to getting people to engage with green spaces. The Green Walks project demonstrated that the real barrier is opening the front door. Rather than directing users to defined green spaces such as parks and woods, the project refocused on demonstrating to users that green surrounds them even in the greyest of spaces.

Prototyping for the Green Walks app also demonstrated that the vast majority of health and wellness apps target women in their 20s, based on the false belief that older populations do not use mobile apps. However, Gen X and the Atari generation are now in their mid-late 50s. They use mobile phones and apps extensively, but in different ways. At the end of the project, the Green Walks prototype focused on:

- Keeping the population between the ages of 55 and 65 active
- Making the best use of limited time and limited mobility
- Providing incentives for going outdoors and helping users find purpose in their activity

The secondary project objectives addressed through the app proved more important than mapping and directing users. These objectives focused on incentivizing people to go outdoors and providing a purpose for taking photographs. For some, using photography to find, embrace, and share beauty in their neighborhood is enough incentive to venture outside. Others derived a sense of purpose by uploading their photographs to the iNaturalist citizen science project and recording the dates at which particular plants came into bud and bloom. Interviews indicated this gave them the feeling of still being connected to a larger community that cared about what they did, saw, and thought.

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