An American Prototopia[1]: or Peachtree City as an Inadvertent, Sustainable Solution to Urban Sprawl

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1. Abstract

Peachtree City is a city with a secondary transportation network, known as the path system. This paper seeks to determine why the path system is so successful and whether there are fundamental spatial, configurational properties which underpin its achievement. This paper examines the axial-line network of paths as a distinct network then as part of the larger, combined system of both paths and roads.

The finding of this paper is that the cart path system, although unintelligible in its own right, serves the purpose of reducing the overall number of cul-de-sacs in the city whilst increasing its axial ringiness. A new measure for calculating the *spatial signature of sprawl* is suggested - the proportion and distribution of circuit lengths in the axial map. The paper continues by discussing the social, economic and environmental benefits of the path system, with the proviso that these benefits arise only from a successful system and that a partial factor contributing to this must be the spatial regularities revealed in the axial analyses. It concluds by suggesting that without the cart path system, Peachtree City would consist of nothing more than aggregations of typical suburban developments with one or two primary road-entrances accessed from arterial-roads and containing a high ratio of cul-de-sacs.

This paper concludes by suggesting how Peachtree City could be held to be the blue-print of a '*protopia',* presenting a principle by which American suburbia could be transformed into sustainable communities and yet do so in a manner which would be distinctly American in character and hence palatable to its residents unlike many current, public-transport focused proposals.

Key words: sprawl, sustainability, walkability, planned community, alternative transportation, EVs, space syntax, axial analysis

2. Introduction

What makes Peachtree City a particularly interesting topic for academic study and what distinguishes it from the ubiquitous, suburban sprawl that characterizes much of recent development in North America is that Peachtree City boasts a network of leisure 'paths' or trails forming a network of 80-90 miles. These trails (2.4m wide, gray asphalt[3]) are predominantly used by its citizens driving golf carts and, to a lesser extent, pedestrians and other modes of non-automotive transport. The most fascinating aspect of the Peachtree City trails, from an urban planning perspective, is that they never constituted part the city's original masterplan (unlike, for example, Milton Keynes' 'Redways[4]' in the UK); with the exclusion of more recent developments, the paths have been 'retro-fitted' in, what could be termed, a bottom-up manner. Today, the local community frequently petitions City Hall to have their neighborhood added to the cart path

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1 The definition for a *prototopia* is a prototype for a utopian urban/suburban development.

2 During the data-gathering and analysis stages of this paper, Dr. Ruth Dalton was an Assistant Professor in the College of Architecture at the Georgia Institute of Technology (Atlanta) and Nick Dalton was an employee of GRTA, the Georgia Regional Transportation Authority.

3 The standard minimum path width has recently been upgraded to 3m (10 feet) with 0.6m shoulders. All new paths must conform to these standards and all new developments must be connected to the path system.

4 The 'Redways' are a network of pedestrian/cycle paths in the city of Milton Keynes, extending approximately 200km (125 miles).

system or even takes matters into their own hands by producing gorilla-style social-trails[5] linking their communities or individual houses to the path system. City Hall has responded with new regulations requiring all new development to be connected to the path system. Unequivocally, the trails are perceived by both residents (bottom-up) and City Hall (top-down) as a success, with the majority of journeys under five-miles in length now being taken by golf cart. Fascinatingly, the genesis of the cart path system was practically unintentional and its resultant success somewhat fortuitous. Despite its inadvertent growth, the current Mayor of Peachtree City is rightly proud of the egalitarian nature of the path system as well as its 'green credentials[6]'.

The question, which this paper seeks to address, is whether the success of Peachtree City's cart path system can be, at least partially, attributed to a spatial, morphological foundation. Furthermore, if it *is* possible to identify the precise manner in which the cart path network and the road system are functioning together, then might these analyses serve to provide a blueprint for how such paths might be introduced into other communities. Finally, the last aim of this paper is to determine whether a spatial analysis of Peachtree City can begin to provide morphological measures for the spatial nature of sprawl.

3. Background and History of Peachtree City

Peachtree City[7] is a commuter satellite-city (or perhaps what Soja refers to as an *exopolis*, the city without (Soja, 1992, p.95)) to the South East of Atlanta, Georgia, USA. It is accessed via Interstate 85[8], a major travel corridor through the Deep South connecting Petersburg, Virginia in the North with Montgomery, Alabama to the South and passing through key Southern cities such as Charlotte and Atlanta en route. See Figure 1, below, for a location map of Peachtree City. The city is accessed directly from Highways 74 and 54 which intersect approximately 1km to the east of Lake Peachtree, an artificial lake created by damming Flat Creek (Satterthwaite, 2005) and which now forms the heart of the city. See Figure 2 for an aerial photograph and city plan indicating the highways, the two main lakes (Lake Kedron to the north and Lake Peachtree to the south) and the city boundaries.

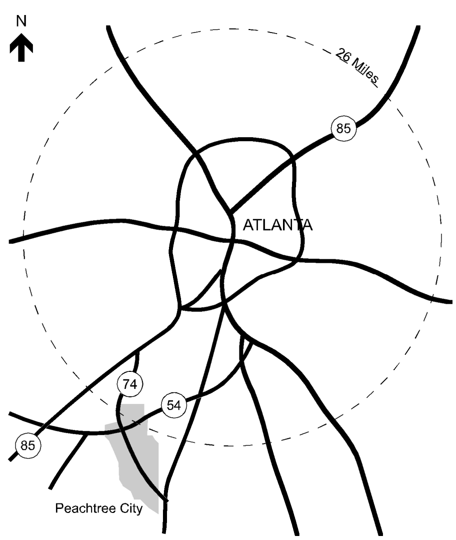

Figure 1. Location of Peachtree City

5 'Social trails' are unplanned, unapproved and resident-built paths ranging from mere 'worn-tracks' to hand-constructed, non-standard path-additions.

6 Golf carts are electric vehicles and hence produce zero emissions.

7 Community website http://www.peachtreecityweb.com/

8 Guide to Interstate 85 can be found at http://www.interstate-guide.com/i-085.html

The city was a planned community built entirely by private developers; it was chartered on March 9, 1959. Its area covers approximately 15,500 acres with a current population of 31,580 (2000 census). Estimates for 2003 indicate a population of 33,010 with projected growth calculations suggesting an ultimate population limit of 45,000-50,000. The population density is currently 524.0/km_ (1,356.9/mi_).

One key aspect of Peachtree City's history was the passing of legislation in 1974 permitting the use of electric golf carts on city streets (Satterthwaite, 2005). This legislation, coupled with the creation of the first asphalt leisure trails, initially as a means of negotiation of land-easements by a utility company wishing to lay sewerage-pipes (Glanton, 2002) meant that by the early seventies the kernel of the present cart path system was already in place. The, almost accidental (and why we use the term *inadvertent* in the title of the paper), pairing of utility pipes and the paths are of morphological importance, a fact which will be discussed later in the paper. Added to this nascent infrastructure, the fact that Peachtree City also boasted three golf courses meant that the means to turn a system of leisure trails into cart trails, namely the golf carts, were already owned and used by a minority of the population. Today, the extensive system of cart paths has become part of Peachtree City's unique identity and a major contributor to its success[9]. There are now an estimated 9,000 golf carts used in the city (Kaspriske, 2003) which means that almost every household owns a golf cart and only a small proportion of these carts of these will ever be used on the golf course.

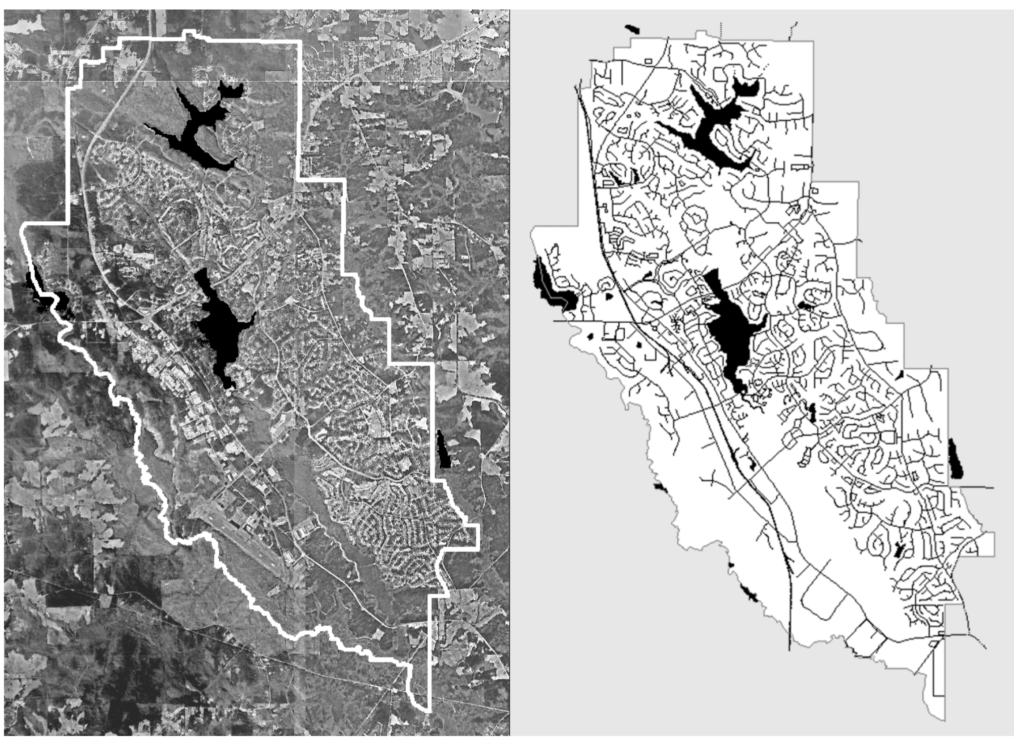

Figure 2. Aerial Photograph and Street Plan of Peachtree City[10]

9 Peachtree City was ranked the 17th best place to live in the Eastern USA by CNN Money Magazine in 2003.

10 Aerial photograph is an extract from, U.S.GeologicalSurvey (Cartographer). (1993). *Peachtree City, Georgia, United States* [Digital Ortho-Quadrangles (digitized and othro-rectified aerial photographs)]. The city map is from Peachtree City GIS database used with permission from City Hall.

4. Methodology

The majority of the field-work and observations were made on two visits in May 2003; a third visit was made in July 2003 in order to conduct additional video observations. On each occasion, we hired golf carts and drove around the cart path system. On the first visit we attempted to traverse as much of the cart system as possible whilst taking photographs and noting the locations of bridges and tunnels[11] (see Figure 3). On the second visit we selected a continuous cart-path route extending as far south as Braelinn Road and as far north as Flat Creek Road (and passing through both integrated and segregated sections of the system as well as three local shopping centres). To make the observations we attempted to drive at a regular speed along the route noting our time at major intersections with a stopwatch and indicating encounters with other golf carts as a 'dot' on a map. On the third visit we attempted to improve upon the hand-observation method (since juggling a map, a pen and a stop-watch in a shaking cart proved extremely tricky) and decided to use a video camera to make the observations. In this way, we reasoned that we could later distinguish between encounters with pedestrians/cyclists and golf carts (or other classifications of social encounter).

Figure 3. View of a Typical Cart Path Tunnel and Bridge Crossing

The base data for the axial line map was provided by City Hall and was extracted from their GIS dataset. We encountered some problems creating the axial map. First, the data which we had was in the form of road/path centerline data with no information on road widths or building set-backs. Since the definition of axial lines is the longest and fewest lines of sight which pass through a spatial system (Hillier and Hanson, 1984), then we were very aware that our modeling would result in an approximation to *true* axial sight-lines. However, during our earlier experiences of driving through the city, we had noted that the density of foliage was so great (more than 20 percent of the city is parkland) that even had this additional information been available we doubted that the resultant axial map would have been significantly different as many potential lines of sight are impeded by the abundant foliage. Equally, in recent years, research into the use of road center-line data (Dalton, Peponis and Conroy Dalton, 2003; Turner, 2005) combined with the use of fractional analytic techniques (Dalton, 2001) reassured us that this approach was valid. However, because of the intricacies of the dual system we were unable to directly use the road center-line data; instead we redrew it in the manner of a traditional axial map. The final mapping problem concerned situations where both cart paths and roads followed the same route and yet were separate; these needed to be modeled extremely carefully. Additional care also needed to be taken to model the crossings of the path-system and the road system correctly.

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[11] In January 2005 we were provided with a spreadsheet of all locations of path underpasses (tunnels) and bridges by City Hall for purposes of verifying our original data.

5. Results

Fractional analysis (Dalton, 2001) has been used in all of the Peachtree City analyses since, due to the excessively curvilinear nature of the majority of the roads in the city, fractional analysis produced consistently better results. There are four axial-breakup maps of Peachtree City (Figures 4-6):

Map A: The contiguous cart path network.
Map B: The entire cart path network with necessary road links to fully connect the system.
Map C: The road network.
Map D: The combined network of roads and cart paths.

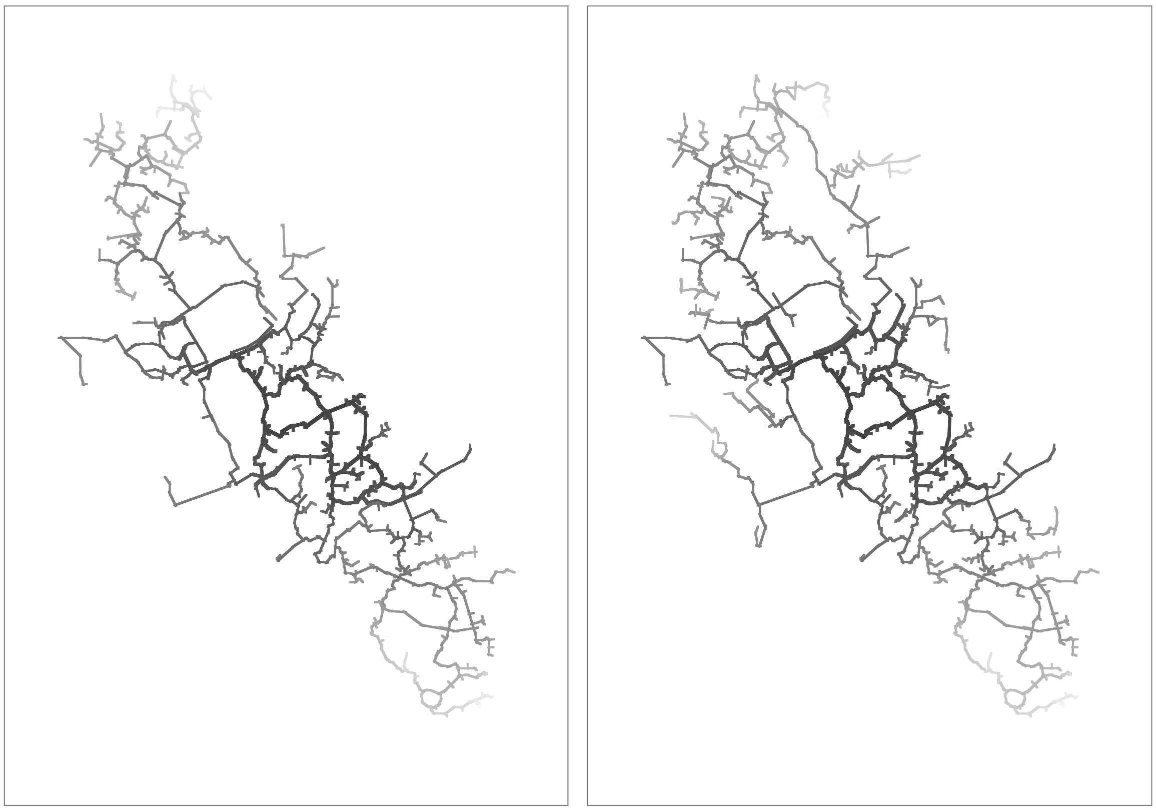

Figure 4. Maps A and B: Fractional Axial Analyses of the Cart Path System (Contiguous System on the Left, Entire System with Road Connections on the Right)

First, consider maps A and B of the cart path network, these have been combined into a single figure, Figure 4. The map on the left shows only the *contiguous* system whereas the map on the right shows the entire cart system with those link-roads necessary to permit the graph, and hence the cart system, to be fully connected. The black lines are the most integrated and the pale grey lines the most segregated. It is evident that there is little or no structure to the cart system when considered in isolation from the rest of the city. The overwhelming result of the fractional analysis is one of a pronounced *centrality effect* which is all the more startling as fractional analysis usually reduces such effects (as compared to other configurational measures). Were the cart path to exist in isolation it would be extremely unintelligible; the correlation, r^2, between integration and integration radius 3 is 0.03.

Figure 5. Map C: Fractional Axial Analysis of the Road System

Figure 5 (Map C) shows the fractional integration analysis of the road system, omitting the cart system. There are a number of features of this map which are noteworthy. First, the pattern of highly integrating roads forms a network which includes a number of the primary roads in Peachtree City. Highways 74 and 54 are clearly highly integrated. Other roads which emerge as high integrators are Dividend Drive, Macintosh Trail, Crosstown Drive, the southern section of Peachtree Parkway and the northern section of Robinson Road. The presence of the lakes appears as 'holes' in the map as well as, surprisingly, the boundaries between sub-divisions (housing developments). Many of the local housing areas (or 'villages') can be identified on the plan due to their clear spatial boundaries. Another feature of this plan is the clear lack of any center as would normally be expected in a town of this size (and as regretted by its founder, Cowan (Frankston, 2002; A.B.C., 2001)). The closest approximation to an integration core is the intersection of Highways 74 and 54.

Figure 6. Map D: Fractional Axial Analysis of the Combined Cart Path and Road System

Figure 6 (Map D) shows the effect of connecting the carts paths to the road system. Again, the pattern of highly integrated lines includes all of the aforementioned roads which emerged as being integrated in the analysis of the road system, but includes other roads; the majority (rather than mere sections) of Peachtree Way and Robinson Road are now more integrated, pulling the pattern of integration towards the southern boundary of the city. Other roads which become more integrated through the inclusion of the cart paths are Flat Creek Road and Kedron Drive. Equally, as in the previous analysis, there is still no proper city center. However, there does appear to be a *nascent integration core* emerging around the Aberdeen Village Shopping Center (off Highway 54) and this core extends as far as City Hall and the Library (at the North West edge of Lake Peachtree, the other side of Highway 54 and connected via the 1972 pedestrian/cart bridge). Through the inclusion of the cart path network, this small integration core suggests that the city is beginning to function as a coherent small town and that this is due, in part, to the cart system. However, by far the most striking effect wrought by the inclusion of the cart path system is the effect on the local housing areas. Sub-divisions which were separated from their immediate neighbours have become connected. The spatial 'chasms' which were evident in Figure 5 are no longer present and the number of 'dead-ends' has been dramatically reduced. In Figure 5, 19.17% of axial lines are 'dead-ends', i.e. have a connectivity of one; in Figure 6, this number is almost halved, to 10.23%. In absolute numbers, the total number of 'dead-ends' is reduced by 94, (a 22% reduction), through the synthesis of the two systems.

Clearly, the act of connecting the subdivisions[12] is helping to provide *cohesion* to the overall transportation network as well as helping to consolidate its small integration core and global, primary street circulation. However, one factor which does not emerge, which is surprising, is that the cart path network does not make the system any more intelligible (the relationship between local and global syntactic measures). The intelligibility of the system remains virtually unaltered.

The morphological importance of the origins of the cart path system (i.e. laid over waste-water/sewerage pipes) can not be overstressed. Since the pipes would have been laid efficiently (as pipe is costly), then the pipe network would have taken the most efficient route possible, minimizing cost. This would have resulted in the original paths following a straighter course than would normally be expected of a network of 'leisure trails'. The 'straighter' the path network, the greater the likelihood of higher mean integration values, as unnecessary depth is not being added to the system. Another advantage of following utility pipes is that they will tend to be most efficient when connecting the greatest number of houses over the least distance. Practically this can be achieved by taking a route between adjacent rear-gardens, connecting proximate houses and adjacent developments (sub-divisions). This has three results; due to the nearness of the backs of houses, the cart paths are deceptively well constituted[13] (even despite the excess of foliage) meaning that they are safer than they would otherwise be. Second, the paths are straighter than they would otherwise be were they not following the line of utility pipes; this has the advantage of helping to make the paths less meandering and hence make the overall system more integrated. Lastly, the efficient positioning of the pipe means that the cart paths can often serve the additional purpose of connecting sub-divisions and 'dead-ends'.

One of the original hypotheses of this study was that the cart paths in Peachtree City were serving to reduce sprawl (a sort of anti-sprawl device). However, in order to investigate this, a morphological measure of sprawl would be required, which was not hitherto available. There are many indicators of sprawl but the majority of them are economic or land-use related rather than *intrinsically* spatial. However, the significance of the reduction in the amount of dead-ends in the system suggested that the amount of 'ringiness' (Hillier and Hanson, 1984, p. 104) in the system might serve to be a good indication of sprawl[14]. In graph theory rings are known as circuits; a *circuit* is a path which starts and ends at the same node (and has a step depth greater than 1, otherwise it would be a loop). In order to investigate the role of 'ringiness' or circuits in axial maps, we developed a method to count the number and length (the number of axial lines forming the path along the circuit) of the circuits. The software program counted only the *minimum number of unique circuits* in the graph. These data, along with a selection of other measures, including axial ringiness[15], are summarized in Table 1 overleaf.

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[12] Subdivision (or 'subdivided land') refers to any parcel of land which is to be used for condominiums, apartments, or any other multifamily dwelling units.

[13] The measure of *space constitution* can be found in The Social Logic of Space (Hillier and Hanson, 1984, p.105) and is simply the number of building entrances opening onto a convex space (or axial line). This is an example of *permeably constituted* space, however a space can also be said to be *visually constituted* if it is 'overlooked' by windows. The implications of spaces being constituted or un-constituted are associated with personal safety and perceptions of safety. Since the presence of a door opening onto or a window overlooking a space implies the potential for the presence of a person (either emerging from the doorway or observing you through the window) then spaces that are constituted are more likely to be safer (or perceived as being safer) than spaces that are not. This is the effect of 'natural policing' through co-presence, or in the case of constituted spaces, *virtual co-presence*. During our cart-path journeys in Peachtree City we were constantly surprised at the degree to which, in spaces which initially seemed secluded, glimpses of back-doors and windows were frequent. The paths were far more *visually constituted* than first appearances would suggest.

[14] According to http://www.planningweb.com the Vermont Forum on Sprawl defines sprawl as "dispersed development outside of compact urban and village centers along highways and in rural countryside." It is interesting to note, however, that of the many definitions of sprawl almost none of them propose morphological measures as indicators.

[15] The definition and equation for *axial ringiness* is given on page 104 in the Social Logic of Space. Axial 'ringiness' is defined as being (2L-5)/I, where L is the number of axial lines and I is the number of islands or rings (or circuits in graph theoretic terms).

	Road System Only	Roads & Cart Paths Combined	% Change
Mean axial line connectivity	2.41	2.70	112 %
Mean axial line integration	0.43	0.48	112 %
Number of dead ends	431	337	78 %
Number of circuits	184	410	223 %
Mean length of circuits	9.33	7.83	84 %
Axial ringiness	0.16	0.25	156 %

Table 1. Values of Measures of the Road and Road/Cart Systems with their Proportional Differences

As well as the vast reduction of the number of dead ends in the system, after adding the cart paths to the analysis, the most significant change produced by combining the cart paths and the roads is the increase in the absolute number of circuits (or rings) in the dual system. By including the cart paths in the analysis it can be shown that there are more than double (223%) the number of circuits in the resultant axial map. Furthermore, it can be shown that the mean length of the paths forming the circuits falls to 84% (i.e. there are more circuits and they are shorter). If the distributions of the circuit lengths are plotted as two histograms (for roads only and the combined system), a striking pattern of differences between the road system and the integrated cart-and-road system can be discerned. Figure 8 shows the pair of histograms.

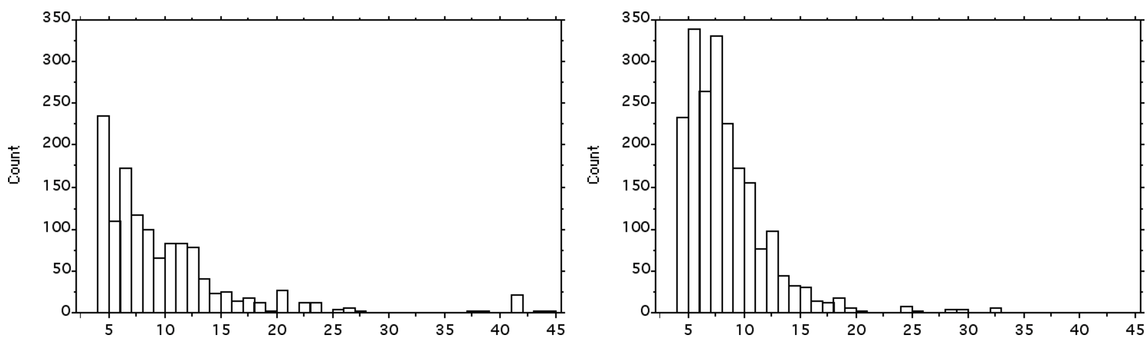

Figure 8. Histograms Showing the Distribution of Circuit Lengths for Peachtree City For Cars (Left) and for Cars and Cart Paths (Right)

First, it is clear that there is an overall increase in the total number of circuits present in the system (an increase of 223%, as previously stated). However, there is also a change in the distribution of the circuit lengths. There is a greater increase in the number of shorter circuits. Prior to the inclusion of the cart path system, the axial analysis of the roads included a number of extremely long circuits (i.e. of circuit length 44). After the insertion of the cart path system, the maximum circuit depth fell to 16. The outcome of these analyses begins to suggest that such a measure describing the *proportion and distribution of circuit lengths* could provide one morphological definition of sprawl.

6. Discussion

Given the above account of the measures and interpretations of the spatial analysis of the cart path system, what are the broader implications of the analysis for the town, its citizens and other similar communities? The first aspect to note is that the implications for the town and its citizens arise solely from the *success* of the cart path system and that *one* contributing factor to the success of the system is its unique morphology. Because the cart path system serves to significantly reduce dead-ends and connect adjacent local areas (evidenced in the increased ringiness of the combined system) then it is inherently *functional* as an alternative transportation system. Add to this, the fact that the cart path system connects residential areas to useful ‘destinations’ such as schools, shopping centers, cinemas and the library then what is created is an *parallel* system that can begin to take the pressure off the road/car network. The three major benefits of having a widespread, functional, integrated cart path system are social, economic and environmental. However, before discussing each of these aspects in turn, it must be noted that these benefits are not automatic; if the cart system did not function well, it would not have the high proportion of usage that it does and the associated benefits would be less easily discerned or simply absent. It is not enough to have a cart system – you have to have the *right* cart system and Peachtree City seems to have got it right.

6.1. Social Benefits

The social outcomes of using golf carts are clear. First and most generally, the intrinsic form of the golf carts means that they are a far more ‘sociable’ form of transport than cars. The electric engine is quieter than a petrol (gasoline) engine, which is of benefit to both the users of the carts and the pedestrians whom the carts encounter along the paths. Second, unlike cars which encase drivers and passengers in steel boxes, the carts are, for the most part[16], open. The combination of the openness of the carts and their lower traveling speeds means that, socially, the effect is more like being a pedestrian than a car driver. As we drove through Peachtree City, our encounter rate (the number of carts we passed) was consistently high and the majority of people whom we passed greeted us, either with a smile, or verbally. If we looked lost (i.e. if we were caught in the act of consulting our map) immediate offers of help were forthcoming, see Figure 8. This was certainly not the kind of experience familiar to car drivers.

Figure 8. Family Outing in a Golf Cart

The other social benefit is afforded specific groups in the community, those who might otherwise be excluded from independent transport: in particular, the young, the elderly and the less physically able. In Peachtree City a young adult may drive a golf cart from the age of fifteen. This not only permits them a degree of independence at a younger age, but means that pressure is taken off the road system during the ‘school run’; older children can drive themselves (and younger siblings) to school, as well as to extra-curricular activities (e.g. soccer practice). Older citizens, who might be unable to drive or equally feel unconfident/uncomfortable about driving a car, can still maintain a degree of independence into their later years. As the Mayor describes, *“Daily activity in suburban areas requires an automobile for transportation. By permitting electric vehicles on our multi-use paths our senior citizens and disabled persons can maintain a normal lifestyle without the use of an automobile, bus, or train. They are comfortable with the low speeds and the lack of interaction with automotive traffic. The greatest benefit is that they maintain their social independence and they are able to remain in their homes.”* (Brown, 2005).

[16] In inclement weather, many carts have clear, plastic, flexible sides that can be ‘rolled-down’ and secured to the frame. More sophisticated carts may have optional solid ‘doors’ which can be attached/removed as necessary.

6.2. Economic Benefits

The second benefit, which also has the potential to create a more inclusive society, is the economic benefit of owning a golf cart. To those more affluent families, it frequently removes the necessity of dual car ownership. According to Bullard (Bullard Johnson and Torres, 2000, p.40) the average American household spends one fifth of its income on *each* car owned. To be able to replace a car (be it for a spouse, teenager or just a local 'run-a-bout') by a golf cart represents a considerable cost saving. Not only is the initial cost of buying a golf cart cheaper than that of a car, but because the carts are electric the ongoing running and maintenance costs are lower too. However, if you are unable to afford even one car, then the golf carts become a necessity rather than a luxury. The barrier to affordable transport (private or public) is a very real one – and the term, '*transit racism*', is a very real issue (Bullard Johnson and Torres, 2000), defined as "*Unjust, unfair, and unequal transportation policies and practices*" (Ibid, p.49). One of the functions of the cart path system in Peachtree City is to provide a private transportation alternative which is financially viable for low-income (and in the USA this is often synonymous with minority) communities. As Mayor Brown describes, *"New low-income immigrant families from Mexico and South America are able to rent homes and offset the high cost associated with automotive transportation by using inexpensive, low-maintenance electric vehicles on our multi-use path system. There is no stigma attached to using electric vehicles on the multi-use path system as exists with mass transit as nearly every household within the city owns an electric vehicle."* (Brown, 2005).

6.3. Environmental Benefits

The final benefits to the citizens of Peachtree City are environmental ones and specifically reductions in congestion, pollution and energy consumption. The issue of congestion has already been touched upon with reference to the 'school run'. It makes sense that if there is a parallel, alternative system which can be used for short-distance trips, then there must be a comparable drop in use of the primary, road system. At certain times of day, this reduction in road traffic could make the difference between whole degrees of level of service on the roads, for example, transforming 'E' traffic flow into to 'F', namely congestion[17]. As Peachtree City continues to grow (and already the city is beginning to feel the strain of congestion (Snow, 1999)), ever greater demands will be put upon its primary road infrastructure and the cart path system will be called upon to play an increasingly vital role as a 'pressure valve'.

The second environmental benefit of using the carts paths are pollution and energy consumption. Golf carts are electric vehicles and are hence produce no particulate emissions. Air quality is a significant problem in the Atlanta Metropolitan Region (Bullard, 2000, p.210; A.R.C., 2002) although, so far, Fayette County has a better record of air quality than other Metro Atlanta counties. Given that the golf carts are used in preference to automobiles in the majority of short, local journeys, then the effect of reducing pollution will be greater, since it is precisely journeys of this distance that are more polluting. On short trips, a car's catalytic converter is less effective and estimates suggest that journeys of up to 5km in length are 50% more polluting than longer journeys[18]. Energy consumption is also less for electric cars than for petrol cars, particularly if the electricity is purchased from renewable sources, equating to further cost savings.

6.4. Reproducibility

What might be the benefits to other communities? Another way of asking this question is to ask whether the success of Peachtree City is reproducible elsewhere. If the success of Peachtree City's cart path system could be translated into a blueprint for retro-fitting a comparable path system into an existing development elsewhere, then these findings could bring equivalent benefits to a larger group of people. Sprawl, smart growth and sustainability are all words which are endlessly defined and redefined with the goal of understanding (sprawl) and implementation (sustainable, smart growth). The spatial, morphological

[17] Motor vehicle level of service ratings (L.O.S.) are a scale of traffic flow characteristics which rank from A to F, where A is defined as free-flow through to E, which is unstable flow, near capacity and finally F, which is forced-flow, at capacity. (Sources: 1985 Highway Capacity Manual [A through F]; Metro [greater than F]).

[18] Mayor of London, Air Quality Strategy 2002.

findings of this paper could help provide guidelines for how an alternative system, such as the cart path system, might contribute to this wider debate.

7. Conclusion

In his book, Towards New Towns for America (Stein, 1973), Stein describes some of the elements of the plan of Radburn, the influential American Garden City in New Jersey begun in 1929. What was interesting about Radburn was that the primary, stated goal was to allow residents to '*Live peacefully with the automobile-or rather in spite of it*'. It was recognized that, unlike England, New Towns of America would need to accommodate the automobile from the very start. The primary means by which Radburn intended to '*live peacefully*' with the automobile was to entirely separate roads and pedestrian routes. Other elements, which were characteristic of the Radburn plan, were the '*superblock'* (an antecedent of the modern 'sub-division') and the '*cul-de-sac'*. The Radburn plan or the Radburn idea went on to influence a generation of planners. However, it is ironic that those aspects of the plan which were intended, first and foremost, to create a *walkable* community have spawned an excess of pale imitations, the developer-built sub-divisions, which are inimical to the pedestrian by prioritizing the automobile. The combination of the superblock and the cul-de-sac, when used without regard for the pedestrian, produces the pattern of suburban sprawl so ubiquitous in America.

One way of regarding Peachtree City, is to say that it has 'traveled backwards' in time. It began with a layout that resembled much of late Twentieth Century suburban America and, through the retrospective integration of the cart path system, has arrived at a layout not dissimilar to Stein and Wright's original vision of a walkable town. Perhaps this is truly a case of needing to look backwards in order to progress forwards. It is the authors' hope that the spatial analyses of Peachtree City might serve the purpose of revealing the reasons why the city's cart path system is so successful and suggest ways in which other suburbs/towns and cities might emulate it. This paper concludes by suggesting that Peachtree City could be used as a blue-print of a '*protopia*' by creating a principle by which American suburbia could be transformed into sustainable communities and yet do so in a manner which would be distinctly American in character and hence palatable to its citizens unlike many current public-transport focused proposals.

Future work which could usefully build upon this work, should include analyses of other dual-system cities, in particular Milton Keynes[19] and its system of 'Redways' in the UK (Franklin, 1999), and of other contemporary planned-communities *without* paths systems such as Celebration in Florida. By conducting such comparative studies, both the uniqueness of and commonalities in the Peachtree City path system could be further clarified.

8. Acknowledgements

To Stephen D. Brown, Mayor of Peachtree City for his generosity of time, accessibility and willingness to talk about the town. To City Hall, Peachtree City for the GIS data and additional information on the location of cart path tunnels and bridges. To Doug Allen of Georgia Institute of Technology for his original ideas concerning the influence of Radburn on modern suburban development, to which we have certainly not done justice.

[19] A space syntax study of Milton Keynes and its Redways was undertaken by Raga Shaddad as part of her doctoral research. The authors of this paper have, however, been unable to access her submitted thesis.

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