

A Study of the Relationship between the Urban Space of School District and Pupil's Paths after School Using GPS Technology

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Abstract. With the speeding up of China's social development process, the problems of the pupils' education and the construction of the primary school district have attracted people's attention. This paper is mainly based on a typical primary school in Hefei, Anhui province of China, using GPS tracing to make investigation. On the basis of the grasping of overall action tracks, we selected some distinctive node spaces such as the commercial space, the square space and so on to make study, and summarize the shortcut effect, circuitous effect, dense lines with hydrophobic points and dense points with hydrophobic lines of the action tracks in different areas. In the end, we master the pupils' choices of path after school and the relationship between the staying in and walking through the space.

Introduction

With the accelerated process of China's social development, the education of pupils and the construction of primary schools has aroused public's concern. But the research on relationship between pupil's activities and their space are started just recently. To better study how the few open areas in congested cities perform their functions in the specific daily events of primary pupils after school. The researcher selects pupils in different grades from Primary School of Hefei University of Technology as participants and adopts action tracing means for investigation. The research to grasp the elementary school the stranded situation and pupil's route choice. Furthermore the research aims to analyze the relevance between the characteristics of pupils' actions and urban spaces.

The research adopts general GPS as experiment equipment, which is able to measure latitude and longitude, speed and direction of continuous tracking points. Via GPS moving experiment means, the researcher deeply investigate the pupil's behavior after school in school districts and deeply analyze the effects caused by commercial space and two significant entrances square towards residential apartment. In order to better understand how the above mentioned factors and open area with different functions affects relationship between related area and pupils behavior and further grasp participants' walking patterns, path selection, delay situation.

Data Processing

The investigation was launched in September 25-28 and October 8-12, 2012. It was sunny or cloudy throughout the process in order to ensure the sensitivity of GPS. The researchers selected primary schools in the center of Hefei in the afternoon during after school hours. They choose pupils from Grade 1 to Grade 6 and follow the tracks with them from school gate to their home incessantly in all processes. 150 sets of valid data were recorded along with the survey, about 25 sets of data for each Grade. Because of the random selection of the participants, and trying to ensure the autonomy of the students going home, the interference is very small and could be ignore, which to some extent ensures the randomness of research and improves the credibility of the data. The survey used GARMIN's outlook handled GPS which was set to record satellite's positioning in every 3 seconds.

Investigation of Pupils' Action and Opening Space

Analysis of Important Opening Space

After a field visit of primaries schools in the urban center, we have found that there are a quite small number of open spaces that pupils have to pass by from school to home, basically including the front-gate business area, the open space in the north, Youth Community and entrance space of Xicun Community. (Fig.1.)

The open space of school entrance and opposite front-gate business area is marked Area A which consists of business stores, temporary stands, traffic lights, pedestrian crosswalk, bus stations and street vegetation. In front of the school gate, there are a series of school transportation facilities such as student channel and parents waiting area. The business area includes stationery store, toy store, book store and eatery. There is an open, flat space in the business area before the school gate. As a special business mode in a special location, this space more or less impacts the travel of students. So we mark it Area B as an open business area which will be contrasted with Area A.

The square space at the entrance of Youth Community is located in the north of the community road, offering a good recreational space for the residents. It's composed of two parts, namely the circular scenic court close to the entrance, which is small but with scenery, and the rectangular square extending along the road, which is equipped with seats, trees, pools and in the east fitness facilities. The square is opened to the road in the community with many entrances.

A road with an open vision just faces the entrance square of Xicun Community. The scenery along the main part of this road is beautiful. But in the north, the environment is not good as there are some old buildings and many disorderly sundries. Most of this space is enclosed by parapets with only two entrances on one side of the road. Consequently, its opening is restricted though it's visible. The south of the square is a temporary parking space.

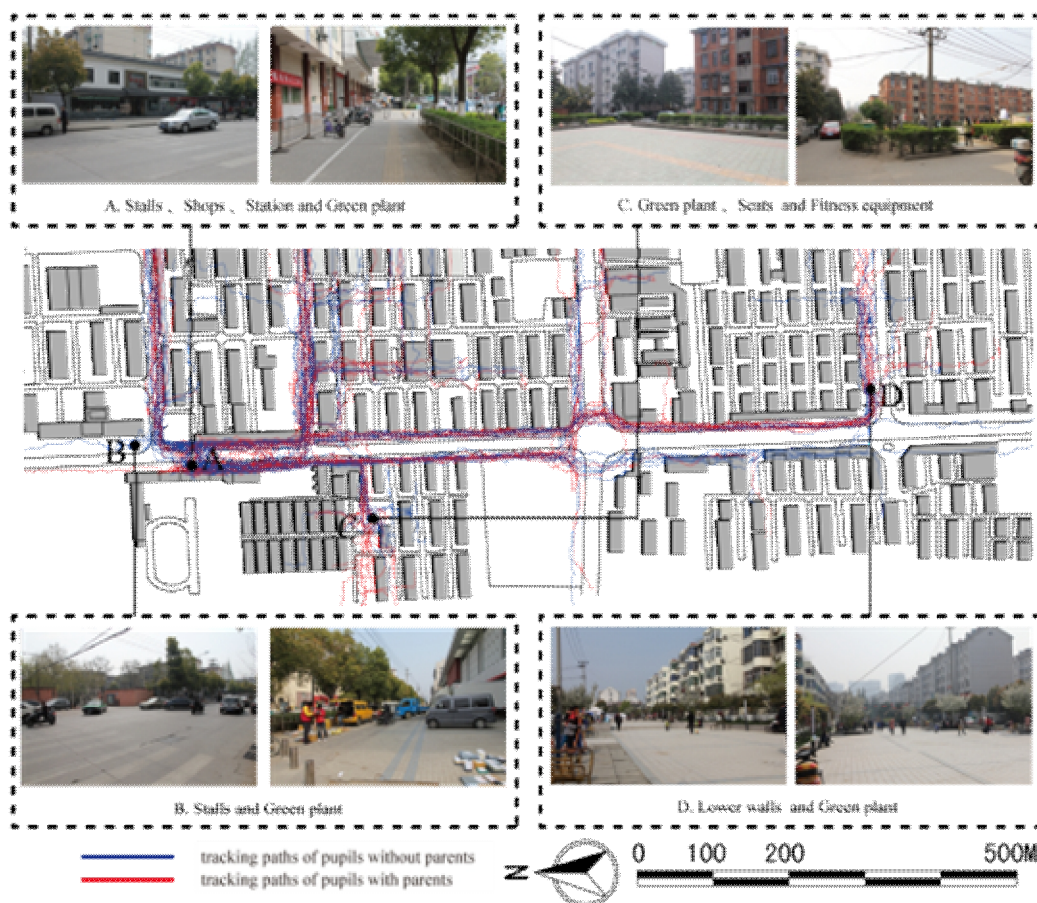


Fig.1. Distribution Map and pupils' Tracking Paths

Basic Information of Tracking Paths

After-school student routes are drawn according to our investigation data. The route is spread to other urban spaces along the roads from the center of school gate area in a clustered way. In sub-roads and communities, the routes are diversified (Fig.1.).

The routes in the business space at front of the school gate are a crowded network while the routes in the east and west of the urban road are an intensive cluster. Besides, the scarcity of routes in the temporary business area in the north is in stark contrast with the intensity of Area A.

Xicun and Youth Communities are enclosed with clear entrances. The routes over there are distributed with the shape of a tree. That is to say, the main road at the entrance is branched to the different buildings inside. So the entrance of each community is an important spatial knot for the after-school trip of students. On the whole, the entrance square is the most intensive space in terms of the route branches (Fig.1.).

Analysis of Staying Situation Based on GPS Data Analysis

Method of recording track points of people every 3 seconds by satellite is adopted for the study. The track points recorded by satellite can grasp motion and stop of people thoroughly and precisely. Fewer points will be captured when the moving pace of people increases, and vice versa.

Action Analysis in Commercial Space

Among the whole school district, record points are most intensive in front area of school gate and commercial area on the opposite side of road. The reason for intensive points found in front area of school gate is that on one hand most pupils pass through the front square after classes and on the other hand traffic light keeps people waiting. Density of record points in the commercial area on the opposite side of road is even higher than that of the front area of school gate and distribution scope is even wider, stating that commercial area effects more on retention of pupils, mainly due to the properties of traffic space in front of the commercial area and the fact that the commercial area on the opposite of school is an important arena for pupils on their path from school and most pupils are willing to see more commercial shops around the school. Nevertheless, the open air stalls substantially influences adversely on after-school activities of pupils, not only influencing critically on retention of pupils, but also occupying walkways. (Fig.2.)

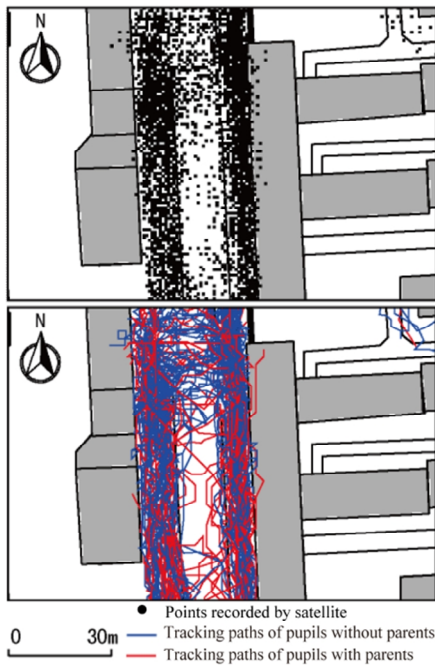


Fig.2. Characters of Points and Paths in Commercial Space

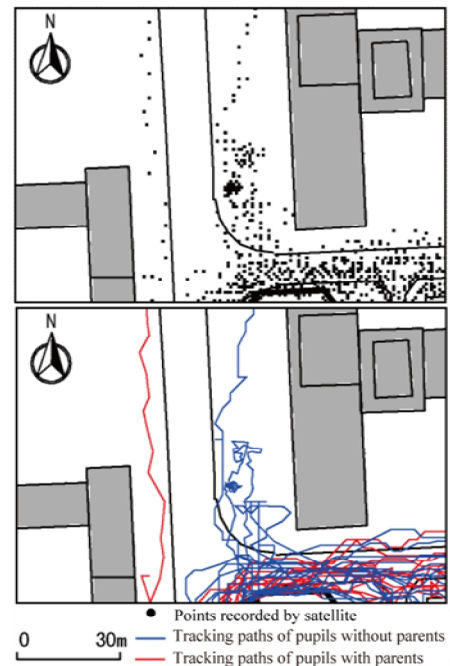


Fig.3. Characters of Points and Paths in Open Space

Opening area B is also studied with some temporary stalls during after-school period, which are mainly engaged in catering. It is found out by comparison that although few lines pass through the area, points are intensive in a small scope of area, forming the pattern of intensive points and sparse lines. It states that the stalls do not over influence path of pupils after school, and only have retention effect on them if they pass through the area or go there with purpose. It is not a concentration area of pupils' paths and does not over influence the traffic condition during after-school time. (Fig.3.)

Action Analysis in Square Space

From the study of record points of open area C it can be found that although 58% of pupils pass through the square, the density of record points is not as high as expectation, even lower than that of road cross nearby, i.e. forming a pattern of intensive lines and sparse points. It means that the location is playing an important role in the city composition, but not has retention effect on activities of individuals of micro level. It is substantially a pure traffic area, and the space environment shall be more improved. (Fig.4.)



Fig.4. Characters of Points and Paths in Xicun Community

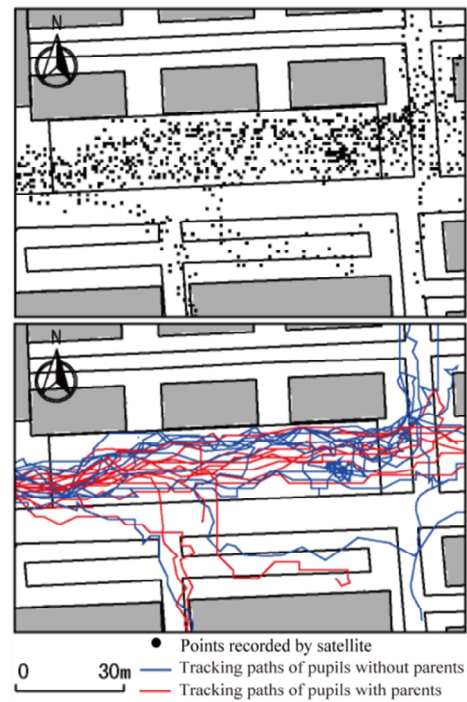


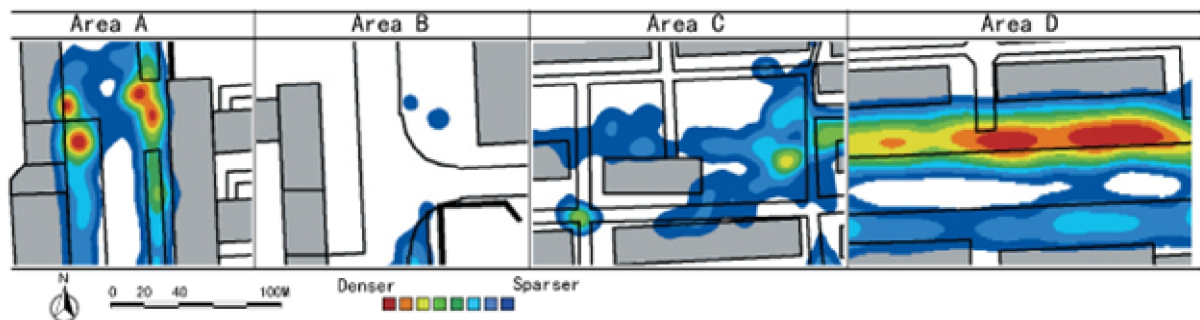
Fig.5. Characters of Points and Paths in Youth Community

From the study of area D in the youth community it can be noticed that the density of points here is the highest in the entry square and most pupils choose to pass through the public square, forming a pattern of intensive lines and points as well. It is known from observation of photographs that tendency of pupils' retention is leading to internal area of the square, with higher density near the chairs, especially at the east entrance of the square and gym area. It shows that this kind of entrance square with good accessibility, abundant spatial elements and comfortable environment not only undertakes the basic traffic function, but also has certain retention effect on pupils (Fig.5.).

Association Analysis of Behavior and Space

Calculation the satellite record point using kernel density method, then compared the results with the track paths and space. In summary, relationship between action characteristics of pupils after school and function of space as well as form can be described as follows:

Table1. The Kernel Density Image for Different Areas



Various effects of action trace characterize the functionality of the range, walk-through effect reflects attraction of the space to the external pedestrians, circuitous effect reflects attraction of combinations of shapes of the internal spatial elements to pedestrians. Circuitous effect characterizes the

functionality of the space and it is more comprehensive or emphasis on static retention and other activities, while walk-through effect characterize the functionality of the space by emphasizing on traffic construction.

Commercial space attract pupils in higher degree, and different spatial elements have different impact on actions and stay of pupils, thereby forming action trail characteristics such as the walk-through effect, the circuitous effect, dense lines with sparse dots and dense dots with sparse lines. Circuitous effect of action trail of pupils occurred in front of the commercial squares and retail stalls, this effect has a negative impact on diverting traffic in the main road space.

Square space inside settlements exerts great influence on staying of pupils , however, this influence depends on the specific spatial elements. Fitness center and featured local space are making pupils staying while traffic nature of squares attributes to pupils walking through without stay in some local space, thus forming dense lines with sparse dots case.

Reasonable commercial arrangement helps create a good business climate, establish space for pupil playing, shopping and communication, so it is the key factor that city construction around schools should concern. Temporary retail stalls are primary focus points of pupils, management of stalls that have navigate impact on traffic should be strengthen, open spaces should be reasonably distributed around schools, and overlapping with city pedestrians shall be avoid.

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