아동의 교통이용 배제의 지리시각화
: 뉴욕주 버펄로 대도시 지역 아동의 방과 후 활동기회

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Geovisualizing Children's Transport Exclusion: Children's Afterschool Activity Opportunities in the Buffalo Metropolitan Area, New York

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요약 : 본 연구는 미국 버펄로 대도시 지역 아동이 희망하는 방과 후 활동과 그 기회를 조사하였다. 아동의 방과 후 활동, 희망 활동, 매일 이용하는 교통 경로, 활동 공간, 그리고 그 안에 존재하는 활동 기회를 설문 조사하여 분석하고 지리적으로 시각화하여 어떻게 그들의 활동 기회가 인구분포, 소득, 교통 체계, 활동 기회의 지리적 분포 등과 같은 사회-공간적(socio-spatial) 요인에 의해서 제약받는지를 살표보았다. 특히 스스로 활동 기회가 배제되었다고 생각하는 아동의 활동 공간 속에 사회-공간적 요인에 의한 불평등이 존재하는지 집중적으로 살펴 보았다. 그동안 교통 체계를 이용한 이동성에 대한 많은 선행 연구가 수행되었다. 그러나, 아동의 이동성이 보편적으로 보호자에 의해 제한을 받는 것은 사실이지만 그들의 이동성에 대한 연구는 극히 제한적이었다. 아동의 더 직접적인 참여와 지리정보시스템(GIS)을 통한 그들의 활동 공간을 표현함으로써, 이 논문은 교통적 배제와 관련된 사회-공간적 제약을 아동의 관점에서 다루었다.
주요어 : 지리시각화, 사회적 배제, 교통이용 배제, 아동의 활동공간

Abstract : This research investigates current and potentially desired opportunities available for children's afterschool activities in the U.S. Buffalo metropolitan area. By analyzing and geographically visualizing travel paths, excluded children's activity space, and existing activity opportunities in the 3D view using GIS, the study looks at how children's activity opportunities are limited by any socio-spatial factors such as racial distribution, median income, current transportation system and geographical distribution of activity opportunity. Especially, it focuses on finding out if there have been children's unequal activity opportunities between the city and the suburban area. There is an abundance of research that has looked at accessibility to opportunities based on the transportation system. However, only few studies have focused on children's mobility even though their mobility is typically constrained and tied to those of adults in the household. With more direct engagement with children and representation of their activity space in GIS, this article is intended to discuss transport exclusion and related socio-spatial constraints from the perspective of children.
Key Words : Geovisualization, Social exclusion, Transport exclusion, Children's Activities space

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I. Introduction

People go about their daily lives by performing certain activities, and many activities are repeated. They are either previously formed activities or new activities with the objective of improving living conditions. However, the constraints that an individual can face in the process of changing his/her activities can be different. Individual's capability can make differences whether or not they can succeed or fail in altering their activities. However, regardless of the individual's capacity to change, societal variables can get on the way. When people are not able to participate in the ordinary social and political activities of everyday life as an active social member (Warrington, 2005) and when they do not recognize that they have basic rights to those activities (Burchartdt, Grand and Piachaud, 2002), it can be said that the individual is 'socially excluded.'

This study investigates current and potentially desired opportunities available for children's afterschool activities in the Buffalo Metropolitan area, NY. There are two main objectives in this paper regarding social exclusion and geovisualization in GISci research. The first is to identify whether children have any socio-spatial constraints, such as transportation system, that will limit their learning opportunities represented as afterschool activities. The second is to demonstrate the power of geographic visualization to reveal excluded children's activity space. Geovisualization techniques presenting individual travel paths, activity spaces, and existing opportunities on a space and time 3D maps are developed to examine the children's activities and the socio-spatial contexts.

Transport exclusion has been identified as a problem of people who has insufficient mobility or lower accessibility. The children's activity space measured their accessibility based on their travel mode and daily activity time budget. With presenting the activity space in time and examining whether their desired activity opportunity is within the activity space or not, it could be found how they have limited accessibility to their after school activity opportunities.

The Social Exclusion Unit (SEU) of UK (2003) reported that children's extra curricular activities could notably enhance their accomplishments, attitudes toward school, and attendance. For children participating in such activities it is important not only to be a good student, but also to be involved as an actor in society. In addition, children learn how they can associate with others and play a part in their society. These benefits enhance social ties. But, unfortunately, it is not that all children have the same amount or quality of activity opportunities. One direct constraint for an individual to participate in his/her activities can be inaccessibility. Many scholars pointed out that transportation system could constrain individual's activity opportunities as well (Hanson, 1995; Church, Frost and Sullivan, 2000; Kwan, 2000; Kenyon, Rafferty and Lyons, 2003; Schonfelder and Axhausen, 2003; Solomon, 2003; Miller, 2004; Cass, Shove and Urry, 2005). In the case of children, where access is most of time not under their control, the impact on mobility becomes bigger. The transportation system can restrict children's opportunities from learning more, for example, by not providing support, setting expensive fares, and having complicated routes.

There is an abundance of research that has looked at accessibility to opportunities based on the transportation system. However, only few studies have focused on children's mobility even though, again, their mobility is typically constrained and tied to those of adults in the household. Children also have a right to say where they want to be, and which service they have to receive. This is why this study is intended to discuss social exclusion and related socio-spatial constraints from the perspective of children. More direct engagement with children and attention to represent their activity space in GIS is needed in this regard. After school activities are closely connected to learning opportunities, besides formal school education, and directly or indirectly indicate children's preference for an activity. Children are exposed to a variety of experiences by participating in extracurricular activities. In fact, it does not often happen that children have the opportunity to do what they want to do. There

are several reasons why this might be including the parents' choice, unavailability of the activity in the area, transportation costs, or costs of the activity.

We begin in the following section with a discussion of social exclusion, transportation, and particularly, children's transport exclusion in the literature. We emphasize the transportation can be a key indicator in explaining socio-spatial phenomenon, and it can serve to shape the individual's daily life trajectory including children's, and furthermore, possible influence on social exclusion. Section 3 describes socio-spatial settings and existing activity types and locations in the Buffalo metropolitan area, NY. Section 4 presents the visualization of excluded children's accessibilities and their desired activity space. Children's activity spaces from the city and the suburbs are compared and an effort is made to identify any correlation between individual's constraints and socio-spatial contexts. Lastly, in the concluding section, we reflect the process and result of this research, and propose a potential future trajectory.

II. Social Exclusion and Children's Transport Exclusion

Social exclusion is a concept that helps explain the causes of why children have limited activity opportunities under the current research context, while also connecting the individual child's problems to the entire social structure. Burchardt, Grant et al. (2002) conceptualized the term as lack of recognition of basic rights or lack of access to political and legal systems necessary to make those rights a reality. However, their conceptualization fails to consider the reflection over time of the various aspects of the relationships between individuals and the entire society. There was a clear absence of concrete explanation of what the basic rights of individual are. Later, Warrington (2005:797) proposed alternatively that social exclusion is "a dynamic, multifaceted process, encompassing both material deprivation and an inability to participate in the ordinary social and political activities

of everyday life." More specifically, the ordinary social and political activities of everyday life might include "employment, health care and education as well as the ability to obtain the resources and services that comprise the accepted standard living for the society" (Miller, 2005:1). In addition, Madanipour et al. (1998) suggest the importance of integration into the common cultural process for equal participation in society, and Miller (2004) adds the inclusion of more general types of social disadvantages in this discussion. As a lens to look at this issue, it has drawn attention to the ways that geographical concentration may plan an important role on the mechanisms of social exclusion (Wilson, 1987). Burchardt et al. (2002) pointed out that the mixture of the various social problems creates acute forms of exclusion that find a spatial appearance in particular neighborhoods. The causes and the indication of social exclusion should be addressed geographically.

Unequal transportation systems significantly contribute to social exclusion. Inadequate transportation can limit access to various benefits that others enjoy (Miller, 2004). The negative effects of transportation such as congestion, accidents, air pollution, and unhealthy levels of noise are also often concentrated in areas with high levels of social exclusion (Social Exclusion Unit, 2002). This coincides with what Burchardt et al. (2002) argued on the negative characteristics that can appear in particular neighborhoods. Surprisingly, much of the researches on social exclusion have ignored spatial or mobility related aspects until recently (Cass et al., 2005). The connection between social exclusion and transportation starts to become a central issue in policy and planning in Europe, the U.S., and a number of developing countries (Solomon, 2003). For example, the Department of the Environment, Transport and the Regions (DETR, 2000) of the UK government identifies four main causes of transportation related social exclusion: spatial, temporal, financial, and personal types. These affect people's access to opportunities that would guarantee their involvement in society. Even though it is encouraging to see more discussion of transportation on social

exclusion, the transport social exclusions described mainly state the physical access to social activities. Transport exclusion explains the reduced accessibility and insufficient mobility of people; however, it only provides a superficial understanding regarding social exclusion. To gain more insight into the causes, travel behavior patterns characterized by the individual's circumstances and socio-spatial setting should be observed.

Transport exclusion has been identified as a problem of people who have insufficient mobility or lower accessibility. When the socially excluded are children, the problem can be more serious. For example, the adequate education is a possible way of offering an opportunity for children to overcome a disadvantaged environment, but children from low-income families may not obtain these opportunities. In some areas, the bus fares home can be a problem as well. To connect children to learning opportunities, it is important to begin by reexamining mobility and accessibility for children. Unfortunately, there is very little literature available about the exclusion of children related to transportation. The subjects typically studied as excluded from transportation are the elderly (Ashham and Warners, 1992), the disabled (Casas, 2007), or female travelers (Kwan, 1999). In this reason, this research examines children's social exclusion as connected to the transportation network. Children are dependent on adult travelers, because they cannot drive and their mobility options are limited by a caregiver. Also, they may not have enough ability to understand the dynamic relations in transportation systems, networks, and space during travel. As Karsten (1998) argues, children have restricted freedom of movement, and they may not be seen as active travelers. However, following Pain *et al.*'s (2001) suggestion, it is important to consider children as active travelers who have the right to participate in activities where they want, even if their motilities are limited. Children can form their own spaces, as well as intensely influencing the geographies of their guidance.

III. Socio−Spatial Settings and Existing Activities

The study area is the Buffalo Metropolitan area in the state of New York. The City of Buffalo is the second largest city in New York State. The area is racially and economically segregated, and these differences form a clear boundary between the city and its suburban region. This distinction may influence children's afterschool activity opportunities and their socio-spatial environments.

The population of the city is 272, 632[1]. The population of Erie County, which includes the City of Buffalo and suburbs, is 913, 338[2]. In the study area, most school districts provide transportation services using school buses for all school-aged children. In addition to that, the Board of the Buffalo Public Schools provides the Niagara Frontier Transportation Authority (NFTA) Metro system for middle and high school students. The NFTA Metro system network exists as a fine dense net within the city, but the ability to use the NFTA Metro public transportation system is not available for children in the suburbs. This results in children in the city having more choices of travel modes than those in the suburbs. Using the different transportation services, children travel to school in the morning. After school finishes, the services carry children home or to an afterschool activity location appointed by their parents or caregivers. Children are provided a transport model to schools, which is part of the required education. However, the transport mode from afterschool activity locations is not guaranteed and it depends on each individual's situation.

1. Racial Distribution

Among various demographics in the study area, the difference in the racial distribution between the city of Buffalo and its suburban areas is quite noticeable. In Figure 1, the pie charts in each census track show the percentage of racial population − White, Black, Asian, and Hispanic/Latino. The size of the pie chart presents
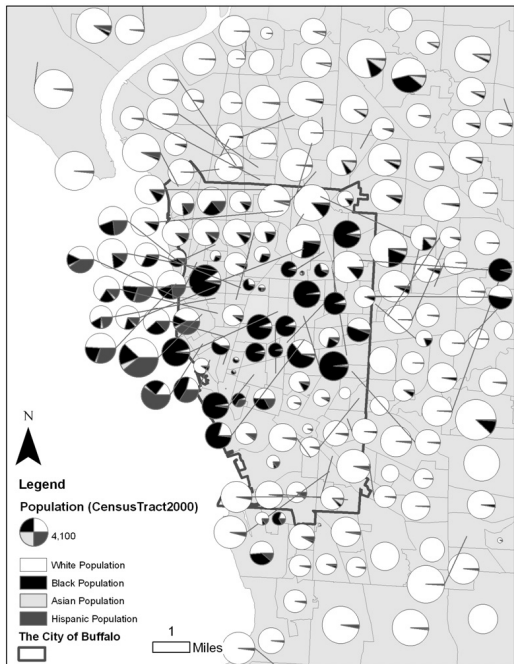
Fig. 1. Population Distribution by Race, 2000, Buffalo, NY

Fig. 2. Median Household Income Distribution, 2000, Buffalo, NY

total population of the different races. The sizes of pie chart are similar throughout the study area; however, the percentage occupied by each race differs in each area. In the suburbs, particularly, in the northwest suburb, White population is dominant, and the percentage of Asian population is higher compared to other areas. The population of Black and Hispanic/Latino is concentrated within the city boundary. The Black population dominates in the East side of the city, while Hispanic/Latino population dominates in the West side.

2. Median Income and Poverty

The median household income also shows the inequality (See, Figure 2). People in the city have lower income compared to the suburban residents. The lowest median household income groups are located at the center of the city, which is the major residential area of Black and Hispanic/Latino population. The northwest area of the study area shows the highest median household income and it is 3-5 times greater than the percentage of the lowest group.
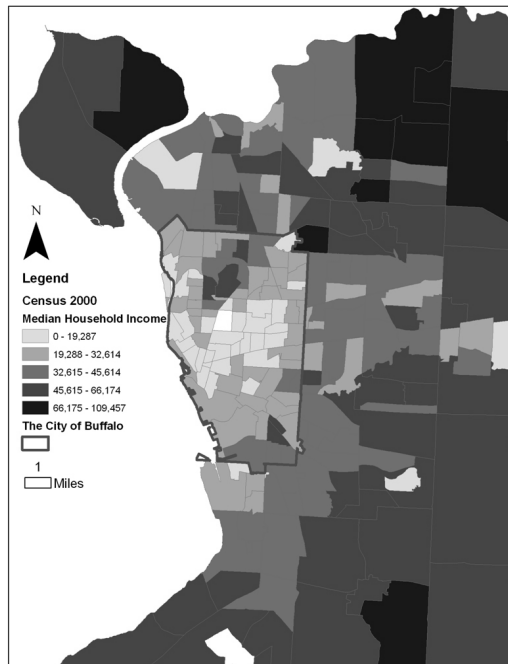
Such inequality becomes more serious when looking at the case of children who live under the poverty level. According to US Census Bureau American Community Survey in the year 2007, the percentage (41.7%) of people below poverty level in the city almost 7 times greater than the percentage (6.9%) in Williamsville (suburb of the City of Buffalo to the east). Similarly, when just looking at children, the difference between the city and suburbs is quite significant.

As racial distribution, median household income, and children's poverty show, there are clearly socio-economic differences between the city and the suburbs in the Buffalo metropolitan area. These distinctive socio-spatial settings may affect children's current afterschool activity choices and opportunities.

3. Existing Activity Types and Locations

In order to find out existing activities for children in the Buffalo metro area, the opportunity table is built

Fig. 3. Existing Activity Opportunity Location and Median Household Income

using a local phone book as well as the on-line yellow pages. The opportunity table contains information including activity type, activity location, available time slots, and tuition and fees (if available). One hundred and fifty-eight activity opportunity locations are collected for the study area.

The activity opportunities are grouped by activity type, and they are arts, clubs, music, sports, and tutoring. As shown in Figure 3, there are many sport activities that exist in the study area. Clubs, music, and tutoring are also shown at various places. Art activities are rare and are located lonely one in suburbs and one in the city. It is noticeable that they major activities within the lowest median household income area are 'clubs' such as boys and girls clubs, youth groups or community centers. Low-income neighborhood children, especially in the city, have more limited access to privately owned activity locations.

IV. Visualizing Excluded Children's Accessibilities and Their Desired Activity

Information about children's afterschool activity and their journey was mainly collected via a survey to the children[3]. Even though children's activity and trips are tied to their parents' decision in most cases, this study weighs on children's decisions and their preferences. So, the survey targets children not their guardians, and it records their thoughts and desires. Children are assured to participate in voluntarily, and they have a full authority to choose whether or not they want to provide their information on this research.

The survey was conducted from May 2008 to March 2009. A total of 92 survey responses were collected. The respondent's age range from 5 to 13 years old. Among them, more than half are between 10 ~ 12 years old. The gender composition is 48 boys and 46 girls.

The survey questions address the children's afterschool activities, activity location, travel between locations, preferences about their current activities, and preferences among activities that are not offered by their particular program. Afterschool activity is referred to every activity children conduct regularly at place, outside the home, and occurring after regular school hours. It can be in arts, sports, clubs, tutoring, volunteer work, religious activity, or scouts. Those activities conducted at home are addressed separately. Children answer survey questions for each weekday. When they have the same activity scheduled for more than two days in a week, the survey is designed to skip those days that repeat the same schedule.

The potentially excluded children are filtered from the survey respondents through the survey algorithm. The respondent is asked what activities he/she would like to participate in and why; whether the activity is available or not; and what can be done to make desired activities more accessible to children themselves. When a child answered that he/she was not able to perform his/her desired activity with some reason, then this study sees the child is potentially excluded from their activity opportunity. Once children are identified as potentially excluded, their current activity locations, such as home, school, and activity place, are identified. The identified location information helps to determine whether any socio spatial factors affect and any spatial pattern exists or not.

Figure 4 shows activity space and travel paths of all excluded children. The activity space represents the limited space to where a child can reach with an available travel mode in given time. The measure for the activity space was developed based on the Space-Time Activity Theory (Miller, 2005). By examining the activity spaces, it is able to compare children's accessibility to their activity opportunities. The existing activity opportunities are displayed as vertical lines starting at the opening hour and ending at the closing hour of the activity opportunity locations. The activity space is presented by a set of activity areas, which are shown as
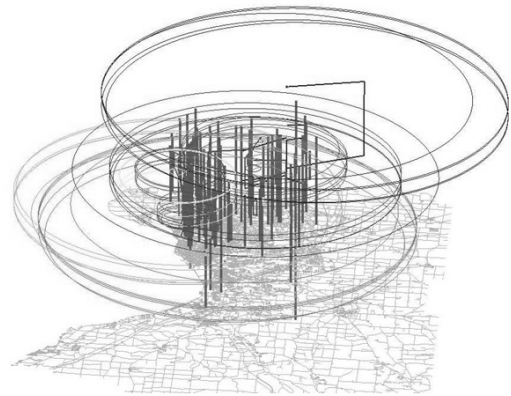

Fig. 4. All Excluded Children's Activity Space and Existing Opportunities(Buffalo Metropolitan Area, 2009)

rounded surfaces on a map. The polylines perpendicularly crossing the center of activity space represent individual travel paths. It is now possible to examine how the individual's activity space includes his/her desired activity opportunities in the activity space.

With the general characteristics obtained from the survey, it is possible to observe the excluded children's location and general activity preference. However, it is not enough to tell how children tie their social environment with their spatial activity trend or territory. Investigating each individual's case can reveal how each child is situated in his or her society, and it can reflects their reality which is often hidden in the aggregated data analysis, and invisible before the geovisualization process. The next step focuses on showing how geovisualization can help us showing each individual child's activity pattern and socio-spatial environment closely (see, Figure 5).

The Figure 5 illustrates each case of the excluded children to compare them. In the Figure 5, Suburb1, Suburb 2, and Suburb 3 are children from the suburbs; and City 1, City 2, City 3, and City 4 are children from the city. These children consider that their desired activity is not available due to a number of reasons – mostly no transportation, no activity place, or their schedule. In spite of what their reasons are, they all consider they are 'excluded' from their desired activity
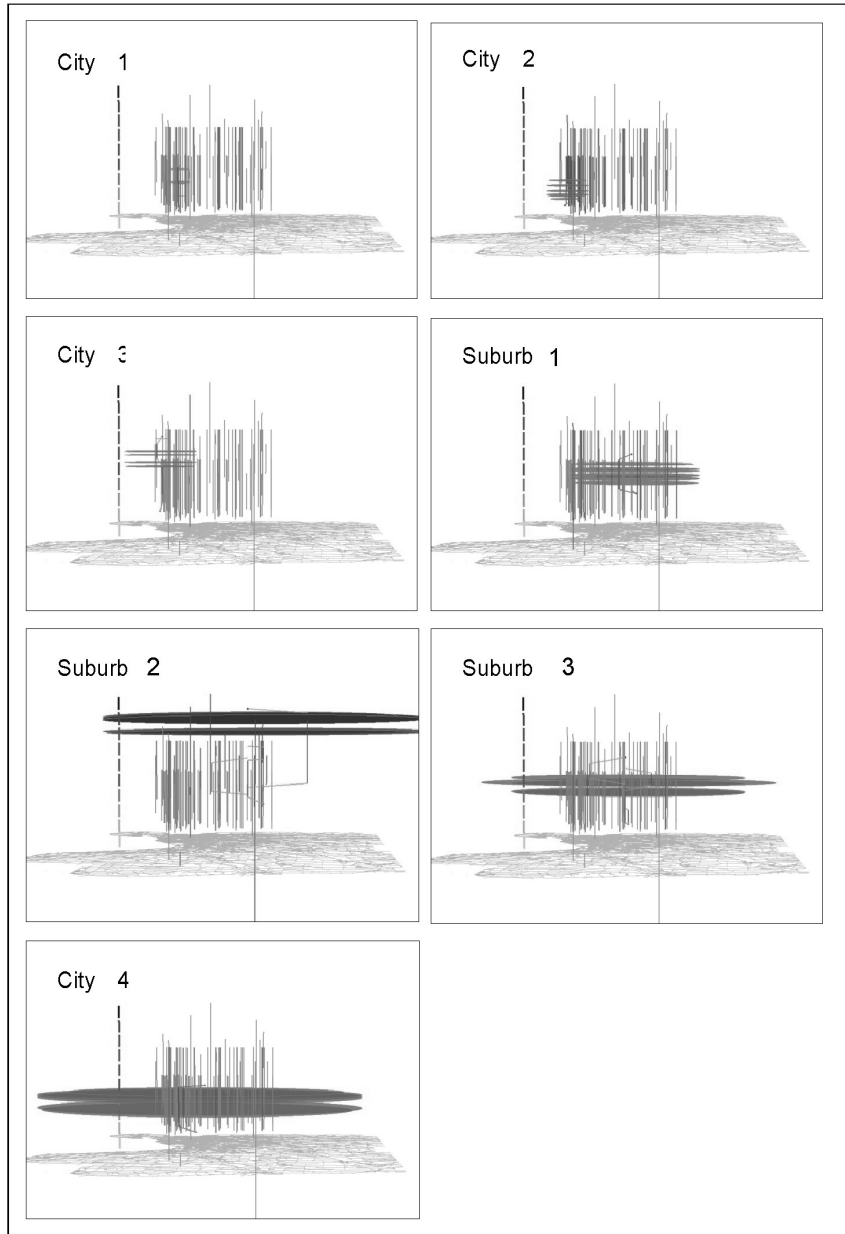
Fig. 5. Individual Child's Activity Space Cross Section(Buffalo Metropolitan Area, 2009)

opportunities; their individual activity spaces have different size and shapes depending on each situation. A point to notice is that there is a clear distinction between the two study areas – the city and the suburbs. When looking at the suburban children's activity space, they cover most and even a larger extent than the boundary of the study area. The suburban children have several trips during the week. Considering their longer activity space, their activities go until later in the evening. In contrast, the city children's activity spaces have smaller extent, and cover only their neighborhood. It is not clear what causes this difference, but it is

obviously noticeable in the geovisualized activity spaces.

Organizing the children's activity spaces by size, especially City 1 ad City 2 have the smallest activity space. City 1 and City 2 state that they want to learn math and need help with homework. City 1's current activity is a center-based activity and City 2 does not carry out any after school activity. City 3 currently attends hockey class and wants to play baseball as his desired activity. His activity space is still small compared to those of suburban children but it is bigger than that of City 1 and City 2. The next largest activity space is Suburb 1. Suburb 1 carries out one after school activity during the week and she wants to learn another music instrument. Next comes Suburb 2, Suburb 3, and City 4. They carry out several activities during the week and their current activity places are located at different locations within the study area. They want sports as their desired activity. Except City 2, parents gave them a ride to their current activity school. City 2 uses a school bus and he does not have a ride to go any activity center. It is interesting that even though suburban children's activity space cover most of the study area and carry out more types of activities, they state that their desired activities are unavailable and that they have limited access. Most children explained that they don't have a travel mode to go their desired activity place and their family daily schedule does not allow them to do.

Arranging these activity spaces by size, it can be noticed that children who have smaller activity space, want activities that helps their formal school courses. The activity space size and shape suggest how children have limited opportunities. By linking their situation and preference based on the survey to their activity space, it is possible to examine the relationship between their socio-spatial situation and real activity and travel.

V. Conclusion

This paper aims at identifying whether children have any socio-spatial constraints, especially the transportation system, that will limit their learning opportunities in the form of afterschool activities in the Buffalo metropolitan area. The outcomes of this research suggest there are existing gap in participating in various types of afterschool activities between the city and the suburbs. Since the city of Buffalo has lower median household income than suburbs, this may indicate the unequal participation.

Most children experience some levels of mobility constraints, and this might be a natural reflection of their travels being dependent on those adults. However, lack of accessibility increases when low-income household neighborhoods are examined. Children in such neighborhoods had significantly small activity spaces when compared to the children in higher income neighborhoods. In fact, they carry out less afterschool activities and desire basic activities for improving their schoolwork. There are different reasons why less afterschool activities are available in various types of neighborhood. There could be less attention to children's secondary education, less accessibility of parents, or less activity opportunities in the neighborhoods. This paper also demonstrates that less variety of activity opportunities exist in low-income neighborhoods, In reality, only 'clubs' and 'community centers for day care' can be found in such neighborhoods of the city. Economically, where a profit cannot be made, private education places would not locate. As a result, children in the city have much more limited access to that type of opportunities. This implies that children's travel behavior and activity opportunities not only determined by their choices but also are influenced by their socio-spatial context. More importantly, geovisualizing individual child's activity space and existing activity opportunities in 3D successfully visualizes and represents children's accessibility in space and time. It was also quite helpful in understanding individual's travel behavior. Better understanding of the socio-spatial context that each individual faces is achieved by linking the geovisualized image to the individual's condition and thought process (reasoning for their choice of activities) acquired from the survey. Particularly, geovisualization

of children's desired activity among the existing opportunities attempts to connect the children's perception with their activity space. This, in fact, allows us to determine if access to their desired activities is possible.

Children's transport exclusion is not necessarily their own doing. It is identified that children's mobility and their activity opportunities are dependent on socio-spatial structure in their community, and the transportation system. The findings indicate other higher-levels' influence on an individual level. The limited mobility and activity opportunities in certain neighborhoods can exclude children. However, children have their own desired activities and they can also use other travel modes such as walking and bicycling. Their willingness for a certain activities may improve their condition. How society supports the willingness and the children's influences on other levels can be examined further in the future.

Notes

1) Source : U.S. Census Bureau, 2007 population estimates.
2) Source: U.S. Census Bureau, 2007 population estimates.
3) The survey form was approved by the Institutional Review Board (IRB) from the University at Buffalo, State University of New York (SUNY) in January 2008.

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