Counter-Mapping the Neighborhood on Bicycles: Mobilizing Youth to Reimagine the City

Katie Headrick Taylor · Rogers Hall

Abstract Personal mobility is a mundane characteristic of daily life. However, mobility is rarely considered an opportunity for learning in the learning sciences, and is almost never leveraged as relevant, experiential material for teaching. This article describes a social design experiment for spatial justice that focused on changes in the personal mobility of six non-driving, African-American teenagers, who participated in an after-school bicycle building and riding workshop located in a mid-south city. Our study was designed to teach spatial literacy practices essential for counter-mapping—a discursive practice in which youth used tools similar to those of professional planners to "take place" in the future of their neighborhoods. Using conversation and multimodal discourse analyses with video records, GPS track data, and interactive maps authored by youth, we show how participants in our study had new experiences of mobility in the city, developed technically-articulate criticisms of the built environment in their neighborhoods, and imagined new forms of mobility and activity for the future.

Keywords Mobility · Youth · Urban neighborhoods · Spatial literacy · Counter-mapping · Bicycles · Geospatial technology · Social design experiment for spatial justice · Thirdspace · Ground truth · Analysis of personal time geography · Desire layers

1 Introduction

Physical mobility is a mundane aspect of daily life. At multiple temporal and spatial scales, people move between places and participate in different types of activity in and across these places. Different forms of transportation (e.g., riding in a car, walking, or riding a bicycle) mediate personal mobility differently, and resulting patterns of mobility structure activities that involve co-participants, technology, and mutually accountable forms of engagement.

K. H. Taylor (✉) · R. Hall
Department of Teaching and Learning, Vanderbilt University, PMB 230, GPC,230 Appleton Place, Nashville, TN 37203-5721, USA
e-mail: katie.h.taylor@vanderbilt.edu

Mobility requires navigation through and negotiation with built environments. While personal mobility provides the fabric of everyday life, it is rarely considered part of learning in the learning sciences, and it is almost never used as relevant, experiential content in teaching (Leander et al. 2010).

We report on a design experiment that explored how changes in youth mobility, using bicycles and geospatial technology, supported teaching and learning new forms of spatial literacy. Youth in our study understood and reasoned about urban phenomena using important spatial concepts (e.g., scale, distribution, density, and accessibility), and they engaged with geospatial information and technology to imagine how their neighborhoods could change in the future.

Studying new forms of spatial literacy is important for several reasons. First, the domain of spatial thinking in education research is understudied (NRC 2006), and new technologies for spatial thinking influence the ways we teach and learn content areas like geography and social studies. Second, spatial literacy is an important component of civic engagement since many democratic processes of urban development rely on representations of space and residents' sustained reflection on experiences within lived spaces. Third, and critical for more inclusive civic participation, youth are typically not viewed as participatory "stakeholders" in processes of urban development (e.g., Dennis 2006; Sanoff 2000; Santo et al. 2010). Finally, geospatial information displays are increasingly common in public media, and technologies like global positioning system (GPS) devices and geographic information system (GIS) mapping tools are now built into the information devices we use on a daily basis (Lee and Dumont 2010).

Our design study focused on spatial literacy that was involved in *counter-mapping*—practices through which residents of a study area make personally relevant claims to public resources for the future development of a community (Peluso 2005; Wood et al. 2010). Counter-mapping typically involves residents:

- collecting information about community assets,
- making maps or new map layers that reflect these assets and aspects of personal use or mobility, and
- using these maps to make and justify claims for use and development of assets in the future.

As a hypothetical example, counter-mapping could involve a group of residents, preparing to comment about a proposed retail development before a city planning group, gathering data about income levels and home values (collecting information), producing maps that illustrate likely changes in traffic (making map layers), and presenting findings and maps publicly to argue in favor of or in opposition to the new development (justifying claims).

Our interest in counter-mapping was to provide youth with new resources for moving through the city, skills in the use of novel (for them) mapping technologies, and ways of thinking about representations and spatial phenomena that would allow them to participate in city planning. Like a conventional design experiment (Cobb et al. 2003), we designed experimental teaching activities that we hoped would support new forms of spatial literacy important for counter-mapping (e.g., analysis of personal mobility and creation of map layers). But our study also included the history of the setting as important content for what youth might learn, and our relations with the local community involved important aspects of collaborative design.

In the sense described by Gutierrez and Vossoughi (2010), we undertook a social design experiment with the explicit purpose of building on the history of the setting—a neighborhood

we called Woodbridge[1]—to create and support youth practices of counter-mapping that could contribute to city planning. We describe this history and co-design further in a later section. But in overview, our study started from the history of Woodbridge and the concerns of adults working or living in the neighborhood (including parents of participating youth). We focused on the interests and desires of youth in the neighborhood, and we provided them with access to new forms of spatial literacy that were related to changes in their mobility (i.e., from walking to biking) and linked uses of geospatial and mobile technologies. We hoped that combining an older technology (bicycles and the urban street grid) with newer geospatial and mobile tools, would lead to changes in personal mobility and participation in new forms of spatial literacy. These included interpreting and building map-based representations, comparing personal activity at different spatial scales, and making spatial arguments about changes to the neighborhood that were personally relevant for youth as residents. By engaging youth in these practices, we hoped to scaffold youth participation in an emerging practice of counter-mapping.

In this article, we analyze selected materials from the larger design study to ask the following questions:

- *Sense-making:* How did youth make sense of the relation between their grounded, "on the move" experiences and more formal, mapped representations of their community? Making sense of this contrast, we argue, was critical for new practices of counter-mapping we hoped to create with youth.
- *Engagement:* How did youth engage with our designed activities to identify personally-relevant aspects of mobility in their neighborhood, both for the present and for imagined, future activity?
- *Learning:* Did youth participation in emerging practices of counter-mapping lead to and benefit from new forms of spatial literacy (e.g., riding bicycles, analyzing personal mobility, and building map layers)? In what sense can we say that youth learned to think about and act on space in new ways?

Our questions assume that as people learn, they make new kinds of contributions to social and technical practices that are changing at the same time (Hall and Greeno 2008). Our approach in what follows looks for evidence of learning in how youth engaged with and contributed to activities we designed, as well as how the organization and meaning of those activities changed through time.

2 Counter-Mapping and New Spatial Literacies

Before discussing the concept of counter-mapping in more depth, we review an example of youth making personally relevant claims to Woodbridge resources for their own and the community's future. This example is excerpted from one of several, culminating presentations of youth-authored maps to adult stakeholders.

2.1 Desire Layers for a Future Neighborhood

In what follows, Carissa and Leah, two teen girls living and attending school in Woodbridge, stood in a university computer lab in front of a digital projection (on a large screen)

---

[1] Woodbridge is a pseudonym for neighborhoods near the center of the city where our study took place. We use pseudonyms for participants, organizations, and named places in transcripts and map images in this article.

Fig. 1 Three new *bike lanes* (*darker, transparent lines*) drawn by Carissa and Leah to connect Woodbridge neighborhoods to the surrounding city

of a map layer they had designed. Their map layer was constructed over a fully functional Google Maps[TM] street map of Woodbridge and the surrounding city.[2] In a presentation facilitated by a researcher (Kris), Carissa described places and routes that she hoped the city would build for non-driving residents of the neighborhood but also for herself in an imagined future. While some of the mapped attributes in her "desire layer" (our term) were fanciful (e.g., a "teen mall" with ice cream stores), others were more personal and practical.

Using a yardstick to trace routes on the projected map, Carissa described three bike lanes she hoped the city would build (Fig. 1[3]). The first connected the entire Woodbridge community to downtown and riverfront areas of the city, running west to east along a major traffic corridor. The second bike lane ran north to south, connected an historic landmark in Carissa's neighborhood (an historically Black university, Deacon) with a well known area for music publishing and recording in the city (Tune Way). While the first bike lane made accessible a range of stores and neighborhood assets along a busy driving corridor through the center of Woodbridge, Carissa's second bike lane was more personal, shaped strongly by her aspirations as a teen who would soon be a young adult in the city.

Episode 1,[4] Carissa presents desired bike lanes to peers, adult volunteers, and researchers

1	Carissa:	Then I have, um (3 s) uh, a bike lane going from Deacon University, > which is my future college, by the way <
2	Leah:	°Boo

[2] Study participants used "My Places" and "Collaborate" functions in Google Maps[TM] to author and compose together "desire layers." They titled the composite map, "SupaaQuery Park," in a symbolic renaming that reclaimed a neighborhood park for youth activity.Query

[3] Our figures are simplified versions of interactive maps used by study participants. We simplified maps in use to make images readable in print.

[4] Turns at talk are numbered for identified speakers. Continuous speech at turn boundaries is shown with = equal signs, while onset of [overlapping talk is shown with left brackets. EMPHATIC talk is shown in caps, and elong:::ated enunciation is shown with repeated colons. ((*Activity descriptions*)) appear within double parentheses and in italics, and > comparatively quick speech < appears in angle brackets.

Table a continued

3	Kris:	OK =
4	Carissa:	=((*to Leah*)) Be quiet. Going [down to this] main road here, °Tune Way West. ((*uses yardstick to trace movement south, from Deacon to Tune Way*))
5	Rogers:	[((*laughing*))]
6	Kris:	So WHY is it important that it goes all the way to there?
7	Carissa:	Because… I'm going to go there, and I would like there to be bike lanes.
8	Kris:	Alright, so those are places that you'd like to be able to go on your bike.
9	Carissa:	Yes::=
10	Kris:	=Ok

Carissa's image of herself as a young adult "took place" in the city by marking up the desire layer of her map with a bike lane that allowed a future-time, college student (herself as a young adult) to ride a bike from her university campus, past her current neighborhood, and into an area of the city that was the center of music publishing and recording. Tune Way remained difficult to access from Woobridge after a long history of racial and economic segregation in the city. As Carissa explained to Kris, "I'm going to go there, and I would like there to be bike lanes." While her second bike lane cut across history in the city and was for her own future, Carissa's third lane was more immediately useful for her and her neighbors.

Episode 1 continued, Carissa describes her third bicycle lane

11	Carissa:	And then, I had another one, oh, on Osage, right here, going from EM Lane down to this interstate right here. ((*uses yardstick to trace from home neighborhood to edge of interstate*)) Forty-five, I think.
12	Kris:	((*laughing*)) Why do you have it going all the way to the interstate?
13	Carissa:	Um, because you can't really drive on the interstate. So like this, like, a lot of people, there's a lot of things right here, that people go to, ((*traces south of proposed bike lane*)) like the places, the park, and the community garden, here. But then not everybody over here has cars,=
14	Kris:	[Ok]
15	Carissa:	=[so I] want there to be bike lanes so they can get from here to there, ((*traces from home neighborhood to edge of interstate*)) and not have to walk.

Carissa's tracing and narration of new bike lanes in a desire layer, built with her partner, Leah, illustrates counter-mapping as a new form of technically-mediated practice for youth participants in our study. Carissa described, with playful comments from her peers, a form of mobility and range for purposeful activity in the city that came into being during our study. Prior to building and using bikes of their own, youth in our study moved between home and school on foot or were driven in automobiles by their parents or other adults.

The routes and activities Carissa described in this excerpt were new, both in spatial range and in the mode of transportation used by Carissa and her peers. As will be clear in more focused analyses later in the paper, Carissa and her study peers were just learning to get around on bicycles, while also learning what the proximal community had to offer to youth on bikes (e.g., community gardens, parks, and shopping opportunities not accessible on foot). Carissa's presentation also involved a newly constructed technical object, the desire layer as an attribute map made by youth while learning to use a suite of mapping

tools. This example illustrates how counter-mapping engaged technologies (biking, the city street grid, user-extensible maps) in ways that were also linked to the identities of youth as they transitioned into adulthood.

In the following section, we dive deeper into the concept of counter-mapping as it intersects theories of spatial practice and children's geography. We then analyze records of two types of activities that we designed to provide youth with new ways of thinking about familiar places. These include a "ground truthing" activity undertaken just as youth began using their bicycles and an "analysis of personal time geography" using GPS devices and conducted after about a week of riding bicycles in the city. Youth participation in these designed activities created new experiences of mobility and uses of geospatial technology that supported counter mapping.

2.2 Counter-Mapping as Thirdspace Practice

Studies of how youth *perceive* space are an important part of the children's geography literature. These studies have been concerned with issues of young people's environmental experience and mobility, looking at how and where young people spend their time across the course of a typical day and what attributes of the geography are important to youth (e.g., Holloway and Valentine 2000; Karsten 2005). These studies typically look at issues of youth access to spaces, and the ways in which young people produce liminal spaces when they are otherwise neglected or denied access. These studies clearly show that youth perceive and respond to the built environment, but they rarely include analyses of what young people *learn* from these experiences related to spatial literacy.

Roger Hart's (1977) study of "environmental cognition" among children was an exception. Hart demonstrated that children's mobility was self-directed in a rural community, and they learned about their environment by traveling through and negotiating how they would use it together. Children were notably involved in making places that invested the landscape with personal meaning. Hart asked children to draw maps of their neighborhoods and other important places from their typical daily experiences. These maps, interviews with children, and ethnographic observations of their activity showed that children had a uniquely rich "time geography" of possibilities for activity given available modes of transit, time, and independent choice (Hägerstrand 1970). These personal time geographies were dependent on children's gender, age, subordination to parental regulation, and the built environment in their community. Forty years later, we found much the same was true of adolescents living in Woodbridge.

There have been fewer studies focusing on what youth need to know in order to *translate* their perceptions of community places to professionally-conceived and "formal" categories of space. Several studies agree that involving youth in this kind of translation is important (e.g., Dennis 2006; Kingston 2007; Sanoff 2000). Bringing youth's first space practices in their daily lives could greatly *inform* the second space practices of urban planners. We agree with Moje et al. (2004) that "these spaces can be reconstructed to form a third, different or alternative, space of knowledges and Discourses" (p. 41).

The interface where residents' embodied experiences in place meet planners' more abstract representations of space is a rich interactional space filled with tension but also with potential for change. For our own analysis and design for youth learning, we began to think of this interface as a *thirdspace* (Lefebvre 1996)—a discursive and imaginary place for finding and producing new ways of thinking and acting in communities, but also as a

means for changing relations between public activity and the built environment. We conceptualize counter-mapping as a thirdspace practice for contesting and building on professional conceptions of space by using endemic and sensuous experiences within the neighborhoods of Woodbridge. Potentially, youth counter-mapping could have consequences both for "on the move" experience and for official versions of city neighborhoods.

3 Methods

Describing our study as a design "experiment" invites the expectation of a clear beginning and end to the study. But our understanding of and relations to adults and youth living in Woodbridge started more than a year before the designed activities we analyze in this article, and our efforts in Woodbridge have continued into the present. In what follows, we describe this history, as it has a bearing on the design of our experimental teaching activities and our analysis of emerging practices of counter-mapping. We also describe those teaching activities, how we recruited and worked with youth participants, and how we gathered information that could be treated as data for our leading questions about sense-making, engagement and learning.

3.1 A Social Design Experiment for Spatial Justice

What we know about the history of the Woodbridge neighborhood came from two sources. First, one of us (Katie) worked for a community organization that provided services to youth in the neighborhood, and of particular relevance to our study, she developed a friendship and working relation with the leader of a Workshop in which youth learned to build bicycles out of discarded or donated materials. That Workshop, which we describe in more detail below, was the setting for many activities in our study. Second, we conducted an ethnographic case study of participatory planning in the Woodbridge neighborhood, for approximately one year before the design study reported in this article began (Taylor and Hall 2011). In that separate ethnography of participatory planning, we participated in and made recordings of public input meetings attended by city planners, neighborhood residents, developers, and activists. We interviewed different stakeholders in the planning process, and what we learned substantively influenced our plans for a social design experiment for spatial justice. Most importantly, we learned that the absence of youth voices in city planning contributed to spatial *in*justices in an area already fraught with a history of racial inequities. We describe how our own history and the ethnography informed our design study before turning to other aspects of method.

3.2 History of Woodbridge and Youth Mobility in the Neighborhood

Our ethnographic case study of participatory planning was part of a larger effort to compare practices of spatial analysis and modeling in settings of professional work (Hall and Leander 2010; Taylor and Hall 2011), with the eventual goal of designing experimental teaching activities for adolescents to learn new forms of spatial thinking and literacy. In our study of planning, we followed a group of city planners as they sought input from Woodbridge residents concerning future development in their neighborhood. During that study and in our analysis of video recordings and interviews taken during planning meetings, three observations struck us. First, adults in planning conversations talked about

Woodbridge youth as being either "at risk" or a source of "risk," but youth were never invited to give input on how the community could be designed to meet their needs as non-driving residents. From our time spent in the community and Katie's work at a local youth-serving organization, we knew that Woodbridge youth were active in the area, and we expected their daily experiences and desires could be highly relevant for planning and design.

Second, Woodbridge was a predominantly African-American neighborhood in a city with a deeply contested, historical struggle for civil rights. The history of efforts to end racial segregation of public and commercial spaces in the city were widely remembered in the local press, yet the fragmentation of Woodbridge by an interstate highway project—which in the late 1960s cut a middle class, primarily African American neighborhood into disconnected pieces—was much less well known. Many of the older residents we met during our study of planning commented on this, and their stories drew our attention to problems of mobility. During our ethnographic study, most public comments that were consequential for planners involved issues of (im)mobility for Woodbridge residents. Residents reported on, and planners were receptive to, the difficulty of getting around Woodbridge, particularly for older residents who remembered walking in a neighborhood that once bustled with family businesses and street life. Now, even residents who owned a car complained that Woodbridge had become one of the city's food deserts, since neighborhood groceries had closed and national chain stores were hesitant to build in residential areas inhabited by families of the working poor. For residents without cars, Woodbridge was also seen as a "mobility desert" (a term first used by Cecil, the director of the Workshop with whom we collaborated on this project) that lacked a comprehensive infrastructure for independent mobility (e.g., bicycle lanes, bus routes, and accessible cultural/educational assets). We later learned that parents of teenagers we studied agreed with this assessment, saying they wanted to get their kids out of the house, but they did not feel there was a safe way to get anywhere without a car.

Third, and particularly important for our design study, only some adult residents made contributions during public meetings that planners found directly relevant for updating the community development plan. Based on our observations and interviews with residents and planners, we suspected that through persistent participation, these residents learned to talk over the surface of maps in ways that closely matched the spatial thinking and relevancies of professional planners. Residents' successful contributions indexed talk about places, routes, and qualities of the neighborhood to graphical representations of particular locations in official maps provided by the city. Successful contributions also linked residents' accounts of past or present experiences to justifications for why the city should invest in new pieces of infrastructure (e.g., sidewalks or expanded facilities at community centers) or policies for the future of the neighborhood (e.g., requiring off street parking for new housing).

In contrast, highly critical, past time accounts of how the city neglected or even harmed Woodbridge (e.g., building an interstate highway through residential and commercial spaces) had little uptake in planning processes that were oriented towards analysis of existing conditions for future development. Residents and planners alike saw criticisms of government action in the past as legitimate. But future development required different kinds of contributions in the participatory planning meetings we studied. Successful contributions usually came from residents who interacted with planning staff over multiple cycles of plan development. Like other stakeholders (e.g., housing developers or food activists), they linked structural conditions in neighborhoods to concrete proposals for new development or policy. Informed by the ethnographic study, we came to think of

counter-mapping as a practice conducted in the interface between residents' and professionals' ways of knowing and acting on space to produce valued places for the future of the Woodbridge community.

3.3 Setting and Activities Designed to Support Counter-Mapping

Woodbridge was home to a bicycle Workshop that had been operating for 3 years when our study began. Cecil, a longtime youth advocate and cycling enthusiast, created the Workshop in the basement of one of the City's most active, youth-serving community organizations. He saw the City as a mobility desert for non-driving adolescents living in an urban environment built for drivers and their cars. With help from adult volunteers, many working in bike shops around the city, Cecil held after school and weekend bike building workshops for teens from all areas of the City. He solicited donated or discarded bicycles as raw materials which, by the time of our study, overflowed the basement space available for storage. Our study coincided with a typical, five-week workshop session for youth living in or around the Woodbridge neighborhood.

Cecil worked with us for three major reasons. First, he hoped to learn new and better ways of teaching Workshop patrons how to read maps and choose appropriate routes for cycling before leaving home. Second, he hoped to see infrastructural changes in the neighborhood that would support youth on bikes, and he knew about our study of Woodbridge planning and ongoing relations with city planners. Third, Cecil wanted to know if his patrons were actually riding their bicycles once they took them home.

Our purpose was to complement the Workshop by designing activities that would invite youth to participate in practices of counter-mapping, and to engage with new forms of spatial literacy as they thought about how their personal mobility was supported or impeded by the infrastructure of urban space. With input from Cecil, we designed activities that would provide youth with experiences and tools to support new mobility on bicycles and, we hoped, to create an emerging practice of counter-mapping. These activities and supporting technologies were interleaved with bike building (completed by the 3rd week), and increased in intensity towards the end of what, for Cecil and adult volunteers, was a typical instantiation of the Workshop. Our designed activities included the following:

- *Weeks 1 & 2:* Youth told stories of their neighborhood activities, alternating between hand-drawn and computer maps (Google Maps[TM]) of the surrounding area;
- *Weeks 3 & 5:* Youth used Garmin [TM] handheld GPS devices both to draw on the surface of the city (e.g., Carissa and Leah drew the word "LOVE" over a 5-block area that included their homes; see Lauriault and Wood 2009) and to complete a neighborhood geo-cache concerning the spatial history of buildings and parks in the Woodbridge neighborhood;
- *Week 4:* Youth compared commercial maps of the neighborhood with their experiences while biking from Woodbridge to a downtown park (a safety ride, described below), while adults recorded the activity using GoPro[TM] head cameras;
- *Weeks 3 & 4:* Youth kept a written time-diary while carrying a GPS data logger (Trackstick[TM]) to record personal mobility over two five-day periods, before and after building a bicycle, and they then analyzed personal time geography visible in these tracks (described below); and
- *Week 5:* Youth used internet mapping tools in Google Maps[TM] and Google Earth[TM] to build and present map layers of desired attributes (e.g., Carissa's desire layers, used to illustrate counter-mapping earlier in this paper).

Experimental teaching activities were completed over a five-week period, but over subsequent months, youth made several presentations of their maps and arguments to neighborhood and city stakeholders (e.g., city and regional planners, representatives of the Mayor's office).

In this paper, we focus on two activities from the fourth week of the larger study. The first was a safety ride on completed bicycles that provided a way to ground truth new areas of the city (Week 4), and the second was a computer lab session for analysis of personal time geography using GPS records of mobility on the new bikes (also Week 4). These provided youth with new experiences of mobility in the city on bicycles, both through embodied activity (the safety ride) and through the use of new representational tools (track and desire layers, interactive online maps of the Woodbridge neighborhood). Youth-authored maps were culminating objects in an emerging practice of counter-mapping, like the desire layer and bike lanes presented by Carissa during Week 5 of the study (the episode that opens this paper).

3.4 Participants

We invited all youth interested in an upcoming session of the Workshop to participate in our study. Six teenagers volunteered for and completed this study. In ascending age order (12–15 years) they were Beth, Wallace, Fred, William, Leah, and Carissa. All were African-American youth attending public schools. Beth, Leah, and Carissa (all girls) lived in a mixed-income housing development (a HOPE VI community) across the street from the Workshop. Of the boys, Fred lived two miles north of the Workshop, while William and Wallace lived six miles east but attended school two blocks from the Workshop. All six participants were familiar with the neighborhood, though less so with the wider city environment in range for the bicycles they would build. Participants were acquainted with one another in various ways before our study began. William and Wallace were brothers, Fred and Leah attended the same high school, and the (separate) parents of Carissa and Leah were so close to William and Wallace's mother that the teens referred to one another as "cousins." Neighborhood and social familiarity were important resources for the spatial activities we invited, recorded, and analyzed in this study.

3.5 Data Collection and Analysis

Across all study phases, we made video and audio recordings of youth activity in the bicycle Workshop, while moving (on foot or bike) in the Woodbridge neighborhood, or while working on or presenting maps in our university computer lab. We also asked youth participants to wear a GPS device for two five-day periods—once before and once after building and using a bicycle—while going about their normal activities at home. During or after many of the activities we designed, we made video records of semi-structured group interviews with youth (e.g., a debrief after their safety ride) in which we encouraged them to reflect on their experiences and explain to us the meaning of representational artifacts they had constructed (e.g., hand or computer-drawn maps). We also collected these artifacts for later, more detailed analysis.

Our study started with a provisional, grounded theoretical understanding of what aspects of spatial literacy were important for residents to make consequential contributions at the interface between local and professional participation in community planning. That analysis, as was the case for analysis of video records of talk and activity in this design study, used methods of video-based interaction analysis (Derry et al. 2010; Jordan and Henderson

1995) and drew from various traditions of more focused discourse analysis. For our work, these included methods of conversation analysis (e.g., Schegloff 1992) and of multi-modal discourse analysis (e.g., Norris 2004; Streeck et al. 2011). Since we were interested in forms of spatial thinking that supported counter-mapping, we also attended carefully to the conceptual content of talk and action with tools or representational forms. Using these methods, our analysis was geared to explore how young people made sense of and used the relation between their sensuous experiences in place and more abstract concepts and representations of space in the service of counter-mapping.

As with any design experiment, but in particular for the broader theoretical and developmental objectives of a social design experiment for spatial justice, we offer our progress in answering these questions as material for refining designs like this in future studies. To the extent that participants' efforts in these activities led to influences or changes that stakeholders valued, our findings also provide material for a theory of social change through new forms of spatial activity and thinking.

3.6 Different Positions on Spatial Justice

We were guided in the study by Soja's (2010) concept of "spatial justice" as a way to intervene in the spatial relationship youth had with their neighborhoods, so that they might imagine new, more equitable possibilities for that geography. Similar to Lefebvre's (1996) idea of the "right to the city," we understood spatial justice to be concerned with empowering those who were most negatively impacted by the urban infrastructure (e.g., inner city residents living in a mobility desert) to take a stance in reconfiguring the city. Harvey (2008) made a similar argument for spatial justice as a living human right:

> The right to the city is far more than the individual liberty to access urban resources: it is a right to change ourselves by changing the city. It is, moreover, a common rather than an individual right since this transformation inevitably depends upon the exercise of a collective power to reshape the processes of urbanization. The freedom to make and remake our cities and ourselves is, I want to argue, one of the most precious yet most neglected of our human rights (p. 23).

Because many urban youth live in neighborhoods that provide little support for their mobility, we took seriously the notion that youth engagement might become essential in processes of city planning, and their contributions to emerging practices of counter-mapping could benefit their futures as well as those of their neighbors in ongoing cycles of urban development.

We have described a social design experiment for spatial justice, but we want to make clear there is no privileged position from which to identify what constitutes a more just arrangement of the urban environment for youth and their families in Woodbridge. As we have shown, adult residents of the neighborhood, city planners, and local activists (e.g., Cecil and Workshop volunteers) all pursued interests that were personal and driven by deeply-held values about what was possible in the City. We also held values about youth-directed mobility and the possibilities of counter-mapping, and these shaped our design efforts. While we learned from our ethnographic study of planning and co-designed with the Workshop leader, Cecil, the design was set before interacting closely with youth who volunteered for the study.

Still, our experiences in the ethnography of planning and our ongoing relations of participation with study participants, their parents, and staff at the community center led us to feel confident that we were working on a problem that had considerable relevance for

youth and the surrounding community. While there was still much for us to learn about youth mobility and spatial literacy, we started the study from a position of "strong objectivity"(Harding 1993, pp. 55–56), working with residents in the community on problems that were important for them. Taking the challenges of youth mobility in the Woodbridge neighborhood as our starting point, we worked with youth to find problems that were relevant for them, and we sought to provide opportunities for them to learn about new forms of spatial literacy. As our study progressed, youth were consistently eager to come to our bi-weekly sessions, were highly engaged, and were disappointed to see the study come to a close.

4 Analytic Findings

We led the article with an example of counter-mapping in a performance for adult stakeholders. In this performance, Carissa explained how new bike routes through the neighborhood would serve her non-driving neighbors in the present, but also herself in the future, as a young college student living in the city. The following sections explore in interactional detail two activities that led to the kind of performance given by Carissa. In the first, adolescents explored their neighborhoods, initially on foot but later on their bikes, using Google Map[TM] street maps that we provided as official representations of the urban environment. We thought of these activities as a form of ground truthing,[5] asking youth to compare their on-the-ground experience with what was shown on a map, and encouraging them to consider how changes to the map could better support their needs or interests. While walking or biking, we expected adolescents to notice places with particular affordances that could be represented as attributes on a map, to encounter dynamic entities that were weakly represented (if at all) on static maps, and to identify routes that afforded relatively safe and efficient movement between places of interest to adolescents. These aspects of life in the built environment of the city were centrally important for counter-mapping activity we found among persistent, adult residents participating in urban planning.

In a second type of activity, we asked adolescents to carry GPS tracking devices with them for 2 weeks, once before completing their bike in the workshop and a second after they had their new bikes. In a computer lab at the local university, we projected track data over an interactive map and asked adolescents to talk as a group about changes in their personal mobility. This *analysis of personal time geography* was designed to give youth a novel form of access to their mobility through time, layered over a map of the neighborhood and viewable at different elevations. We expected both types of activity—ground truthing and analysis of personal time geography—to provide material for youth counter-mapping as their participation in the study progressed.

In the following sections we analyze excerpts from each type of activity, selected as youth completed and began riding their bicycles. In the ground truthing selection, adolescents took their newly constructed bikes on a "safety ride" over a route they planned

---

[5] One meaning of "ground truthing" arises from remote sensing, where data gathered remotely (e.g., reflected light captured by satellite) are compared with independent sources of information about features known to exist on the ground. A more critical meaning of the term (Kwan 2004; Pickle 1995) questions whether maps or GIS technologies ever represent more (or less) than the interests of their makers. Our use draws on both meanings—we assume youth have legitimate experience "on the ground" in their neighborhoods, but in counter- mapping activities, we encourage them to question what is (or could be) depicted in conventional, map-like representations.

and with support from adult instructors and volunteers. Youth planned the route using a Google Map^{TM} that we provided, and their experiences during the ride yielded discoveries that were used later to talk about how existing maps did or did not support bicycling.

In our selection from the lab-based analysis of personal time geography, adolescents explored patterns in track data, but they also struggled to create narratives that explained their activities under scrutiny from their peers. While ground truthing involved critical reflection on the adequacy of urban infrastructure for bicycling, the analysis of personal time geography invited stories about adolescent life and how acquiring a bicycle might create new opportunities for activity. Both activities involved re-mediations (Cole and Griffin 1983) of youth mobility—one related to building and riding a bicycle along a route planned with a map, the other involving a novel use of scalable maps with GPS track data to explore the details of everyday life in sometimes surprising detail. We argue that by participating in these activities, youth began to understand real and abstracted urban space differently, which afforded new opportunities for imagining and showing their futures within that space.

4.1 Ground Truthing the City on Bicycles

The first activity we analyze was a "safety ride" (a Workshop term) in which youth rode their new bicycles beyond the parking lot of the Workshop for the first time. After a tutorial on how to ride together, youth used a Google Map^{TM} traffic map of the downtown area to select a route from the Workshop to a major community park. They rode the route as a group with adults, then while cooling down in the park, they discussed their experience and answered questions by adults. As we expected, the safety ride led to a critical reflection on the extent to which maps supported riding, but also to a discussion of whether the city, its roads, and cultural amenities were arranged in space to support mobility and access for youth on bicycles.

4.1.1 Reading Maps for Riding

Youth were given a map with a destination and resting place labeled (waypoints in Fig. 2) during a bicycle safety tutorial and before setting out together on bikes. In the safety tutorial given by Cecil, the ride had rules and consequences, by analogy to a "final exam." The rules described a *riding formation* (our term) with adults in the front and rear. Youth were to stay between these adults. Hazards should be called out, so that other riders could avoid those hazards (e.g., storm drains could trap a bicycle wheel, sending the rider over the handlebars). Since the ride was downtown, it was illegal to ride on sidewalks. Instead, youth were told to use a bike lane, if available, or to stay to the right of the road in the shoulder and obey the same rules as a car. Cecil promised to withhold any participant's completed bike if they did not follow the rules and behave appropriately on the ride. Youth were then asked to choose a route for the safety ride using the paper map.

Participating youth had widely different facility in reading the conventional scale map we gave them. Some were unable to find the location of the Workshop, and all struggled to distinguish between streets that were passable by bike and other routes that were not (e.g., railroad lines and interstate highways). After intense discussion and tracing of routes around familiar, mapped landmarks in the Woodbridge neighborhoods, youth eventually selected a route that was approved by the Workshop leader, Cecil. They did not notice or choose official bike paths shown in the map, but instead chose a shorter route that independently matched Cecil's preferred route to the final destination (he did not recommend this route to them).
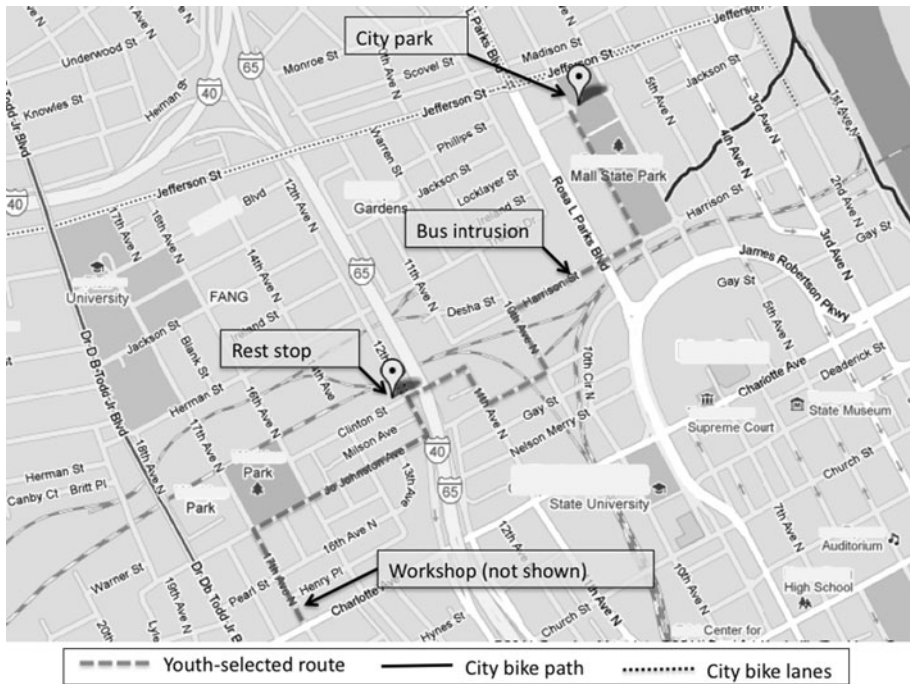
Fig. 2 A commercial map used by youth to plan a route from the Workshop (shown here, but not as a waypoint on their map) to a city park for the safety ride (Mall and State Park). City bike paths and lanes were shown in the original map used by youth

With a route approved, youth folded and put away their maps and began massing in the Workshop parking lot. While our study group included six youth, a much larger group of youngsters had recently built bikes and came along for the ride. Including adult volunteers scattered through the riding formation, 17 riders set out for the city park. The safety ride covered 1.6 miles and took 21 minutes to complete.

4.1.2 Riding as Reading the City

We intended for the safety ride to provide an opportunity to experience or read the city, by comparison with what was shown for automobile drivers on the official map tucked away in riders' pockets. In fact, during the scorching hot ride, youth rolled past the designated water stop, got lost in a light industrial area of the neighborhood, and huddled together under a freeway overpass to again scrutinize maps they retrieved from their back pockets. The relation between their mapped route and the experience of riding on city streets was fragile but recoverable.

It is also important to point out that youth did not ride alone, but in a sizable formation that departed, somewhat chaotically, from the Workshop parking lot. The riding formation served as the environment for learning to operate a bike safely and for collectively detecting and fixing kinks in the bicycle before the youth took them home. But the riding formation was also something worth learning about (i.e., how to ride together in the city). We now describe a predictable but still terrifying and dynamic intrusion during the safety ride (see Fig. 3).
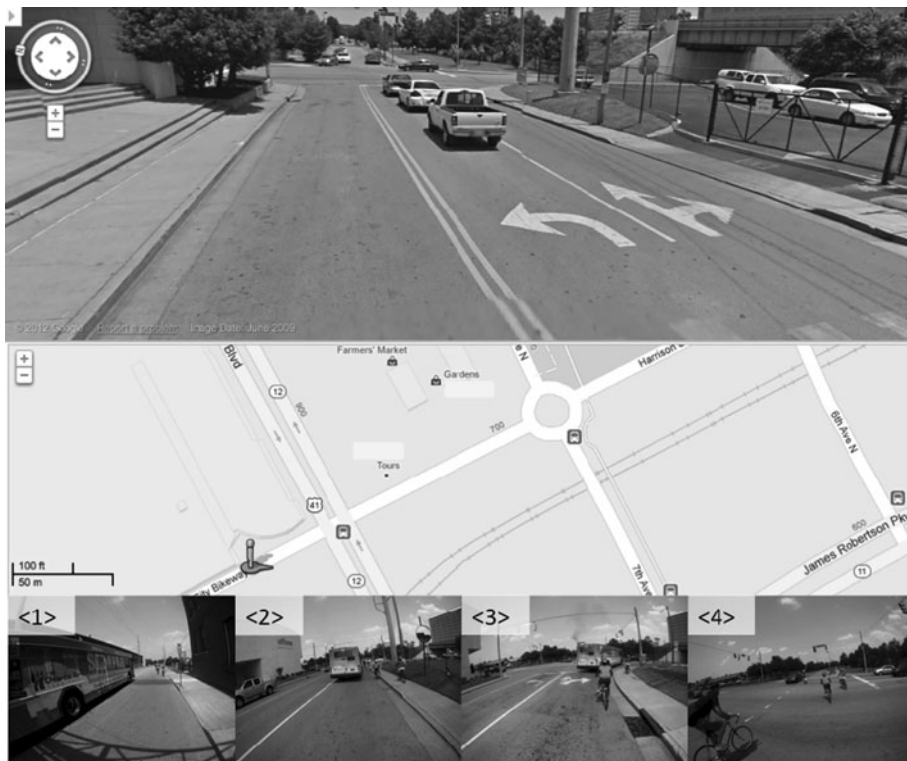
Fig. 3 A city bus (*bottom image* sequence) intrudes upon the safety riding formation as they approach a busy intersection with a traffic light and protected turn lanes (*top and middle images*)

The route presented a series of challenges to the riding formation, not least being an initial hill that many youth found challenging to climb (some dismounted, while adults demonstrated how to shift into lower gears as traffic streamed by). Youth also had to negotiate different kinds of intersections along the planned route, including traffic lights with various configurations of turning lanes and 4-way stops. As any experienced rider would know, negotiating with cars or other vehicles at intersections is a constant challenge to riders in urban environments. Just in leaving the parking lot, most participating youth did not know how to negotiate legal right of way with cars, so adult leaders shouted instructions forward and back along the formation, positioning their bicycles in ways that were highly visible to car drivers along the route.

In the following excerpt, a city bus overtook the riding formation from behind, resulting in an intrusion that was terrifying for youth and a challenge for adults helping to maintain the formation as the entire mass—bikes, the bus, and cars at cross streets—arrived at an intersection with a traffic light and marked, turning lanes (Fig. 3).

Excerpt 2 A city bus intrudes upon the safety riding formation as they approach a busy intersection

1	Otto:	BUS! ((*wearing head cam, looks back*))
2	Wallace:	[BUS! < image 1, Fig. 3>
3	Katie:	[BUS! (2 s) BUS! ((*wearing head cam, looks towards Leah and Carissa*))

Table c continued

4	Bus:	((*roars past Otto on left*))
5	Leah:	((*drives onto sidewalk as bus passes her*)) < 2>
6	Otto:	((*to Wallace*)) Bo::y those buses are scary! I tell you what. (4 s) ((*looking ahead as bus passes girls*)) [Hah hah!
7	Bus:	[((*signaling right turn, begins turning in front of Leah and Carissa at intersection*))
8	Dirk:	((*rides up thru lane, along right side of bus and enters intersection*))
9	Bus:	((*stops turning right, as Dirk passes*))
10	Carissa:	((*stops, foot on curb*))
11	Dirk:	((*stops and stands bike in middle of intersection*))
12	Bus:	((*belching exhaust, bus accelerates through right turn*)) < 3>
13	Carissa:	[Ah::! ((*screaming, wobbles into intersection behind turning bus*))
14	Leah:	[Ah::! ((*crosses intersection as light turns yellow, then red*)) < 4>
15	Otto:	((*passing Dirk, who holds cross traffic with a green light*)) You ladies almost got PLOWed by that city bus!
16	Leah:	I was scared! I got up on the sidewalk.

As the intrusion started, three adult chaperones already "enclosed" youth in the riding formation. Cecil was out in front with Dirk (both adults), Katie was in the middle, and Otto (along with another volunteer) was at the rear. Youth riders were spread between, with one brother (Wallace) at the rear (near Otto), Carissa and Leah together near Katie, and the older brother (William) ahead with Cecil. Both Katie and Otto wore head mounted cameras, providing two perspectives on the unfolding action. This formation of riders, with adults in bounding, protective positions, was stable as the bus roared up from behind.

On hearing the bus, Otto shouted, "BUS!" Just seconds later (before the bus was visible), the younger brother (Wallace) and Katie loudly repeated, "BUS!" for riders up the line. The riding formation with adult borders was operating as a system, as intended by Cecil and understood at some level by the participants making it up.

Ahead was an intersection with a green light and separated turn lanes (Fig. 3). As the bus streamed past on the riders' left (image <1> at bottom of Fig. 3), it signaled a right turn at the intersection. As the bus slowed to begin a right turn (image <2>, directly in front of the girls), Leah steered up onto the sidewalk to avoid the bus (Turn 5). Neither of the girls nor Katie could see the intersection or traffic light, given the height of the bus as it waited to turn. Simultaneous with this, Dirk (a volunteer mechanic at the Workshop) rode deliberately along the right side of the bus, then into the middle of the intersection and stopped (Turns 8 and 11). This move made his intention to continue through the intersection clear to the bus driver, who waited for him to pass. But at Dirk's stopped position, he also was unable to see the girls and Katie behind the waiting bus (image <3>).

After the bus completed a (legal) right turn, Leah hopped her bike off the sidewalk, then she and Carissa rolled, screaming (Turns 13 and 14) into the intersection, just as the traffic light turned yellow. Dirk continued holding cars on the busy cross street, while the remainder of the riding formation pedaled through the intersection against a red traffic light (image < 4>). As they all cleared the intersection, Otto closed on the girls and announced (Turn 15), "You ladies almost got plowed by that city bus!"

Getting lost in the blazing sun, adjusting the route to pass under an interstate, and dealing with the dynamic intrusion of a city bus provided the kinds of experiences we expected of the safety ride. What appeared as a straightforward line on the map used for

planning became considerably richer and more challenging for youth as they rode bicycles through the city for the first time. Remarkable even for adult Workshop volunteers, the bus intrusion required an interactive response from the riding formation, which for youth became a dynamic setting for learning to ride in the city. What seemed comical to youth *before* the ride (i.e., during the tutorial they laughingly volunteered dogs and cars when asked what to watch out for), overtook them from behind as a form of trouble demanding immediate action. Dynamic responses by Dirk, Katie, and Otto provided a form of repair that maintained, over time and through space, a relatively stable version of the riding formation.

4.1.3 New Mobility Invites Thinking Across Scales

The bus intrusion (and repair) was a topic for animated conversation in a semi-structured group interview video recorded in the park at the end of the safety ride. Initially mentioned by Otto and Dirk, who grumbled that city buses saw them as "fire hydrants" and not legitimate vehicles, the bus was discussed intensely by younger riders. Carissa described being "stuck between the bus and the sidewalk," then she and Leah agreed the bus driver was "rude" and "ignant" (typically, Leah was playful in her talk). Shifting closer to their experiences on the move, Carissa, Leah, and William reenacted the intrusion, with Carissa making the sound of beeping horns (from surrounding traffic, not audible in the head cam record), hunching her body as if squeezed by the bus, and screaming—"Cause I was like, a::::h!"—as if riding through the intersection again (Turn 12, above). As we expected, riding in formation through the city provided youth with experiences of routes that were (tenuously) passable for bikes, but they also experienced dynamic, interactive exchanges with other bike riders, drivers in moving vehicles, and a transportation grid designed and built primarily for vehicular traffic. Youth engagement and thinking about the mismatch between mapped and lived experiences of riding in the city was evident as the debrief interview continued.

When talk about the bus intrusion trailed off, Katie and another adult volunteer (Caleb, a specialist in GIS mapping) asked how the map used by youth reflected their experiences during the ride. The desirability of bike lanes—a topic that did not come up while planning the route—received sustained discussion. Adults asked if youth noticed bike lanes shown on the Google Map™ street maps they carried, and after retrieving the maps yet again from their pockets, youth reported they had not. Caleb and Katie asked where they might like the city to create bike lanes.

Looking at their creased and damp-from-sweat maps, William and Carissa jointly described placing bike lanes in a way that offered both safety and rapid access to desired locations. At the beginning of the conversation, William adopted the stance of a rider, weaving his body (with linked gestures) to show a contrast between routes that turned "every which way" and those that used "a lot of straight streets." In the excerpt below, Carissa revisited this tradeoff, arguing that bike lanes should be created on busy streets for direct access to where people want to go.

Excerpt 3: Realizing Tradeoffs for Bike Lanes

1	Carissa:	It's easier to ride on the=
2	William:	[where on the bigger streets]
3	Carissa:	=[ride on the less busy streets.]
4	William:	Yeah, it's less dangerous.

Table d continued

5	Carissa:	Where you need to get to certain places, it's more dangerous, so you need °bike lanes,° so that you CAN get through.
6	Caleb:	Pro:bably, do you think it's FASter to use the bigger streets?
7	Carissa:	[Yeah.]
8	William:	[Yes.]
9	Caleb:	OK. So you could stay straight on the bigger streets=
10	William:	=Um hm.=
11	Caleb:	=if you had a bike lane =
12	Carissa:	=Yes, [cause the st- the busy streets]=
13	Caleb:	[It would be safe AND faster.]
14	Carissa:	=seem to go everywhere important.
15	Caleb:	OK, right.
16	William:	And then like on the less busy streets are like weaving in and out and stuff.

Responding to adults' questions, the riders reflected on their experiences at different levels of spatial and temporal organization, ranging from intense affective responses to what they perceived as mortal danger in the moment at an intersection (e.g., Carissa's original and reenacted screams of terror) to William's more contemplative comparison of streets that were relatively safe and quiet, but slow for cycling because of "weaving in and out," with streets that were straighter and faster for riding but more dangerous because of traffic. Carissa's tradeoff—to build safer bike lanes on straight and busier roads because they "seem to go everywhere important" was a discovery borne both of reading maps for riding and from reading the city on a bike. The ride and subsequent conversation provided youth with an opportunity to think about negotiating the relation between mobility enacted on-the-ground and represented from a disembodied position overhead (i.e., a commercial map for vehicular traffic). Equally important, Carissa's way of thinking about mobility as access to cultural assets in the neighborhood approximated conversations we found among planners and more persistent residents in our earlier study in Woodbridge neighborhoods. These were the materials for counter-mapping that we hoped would emerge in the safety ride, and as we have shown, they appeared again in maps constructed by youth to express changes they would like to see in the neighborhood.

While we were not able to follow their subsequent use of bikes as closely, we have evidence from personal tracking data that youth gathered a bulging portfolio of relevant experiences and skills for solo and formation riding—choosing routes that connect, getting through intersections of different types, using gears to climb hills, and negotiating right of way with motor vehicles. They also began to notice aspects of the street grid that both supported (or could support) and impeded mobility on bicycles and on foot. These distinctions, along with a more sophisticated conception of routes and access to cultural assets in the city proved valuable for subsequent activities of counter-mapping.

4.2 Analyzing Personal Time Geography

Our second episode comes from a session in which youth looked at their own mobility, captured using a GPS device (a Trackstick[TM]) after taking their new bicycles home. This session occurred in our university computer lab and was facilitated by Kris, a colleague

and researcher on this project. All participating youth, Cecil and Dirk from the Workshop, and researchers were present for this session.

Youth were asked to carry a GPS device with them at all times during two, five-day intervals—once *before* and once *after* completing their bicycles. We expected the resulting set of tracks (spatial locations, time, and speed) would provide a partial record of their *daily round* of activities in Woodbridge neighborhoods. We thought of the daily round as patterned traversals through space and over time, presumably directed towards purposeful activity, that youth could write about in time diaries we asked them to keep, or explore later using internet mapping tools we provided. Participants understood that when they returned to the workshop we would gather their tracks, lay them over the surface of an interactive digital map, and look at and discuss them as a group.

We had several reasons for designing this activity. Cecil, the director of the Workshop, wondered if youth mobility changed after going home with a bicycle. Related to this, we wanted to know what sense youth would make of GPS devices and the data layers they provided for spatial analysis and modeling. We expected that capturing, displaying and making sense of personal mobility over multiple days, and with different means of transportation (walking, biking, or being driven), would lead to changes in how youth understood their relation to the city and its assets. We also expected that reflections over their daily lives would provide youth with opportunities to imagine different activities and arrangements of the built environment in the future (i.e., materials for counter-mapping).

Asking youth to capture, display, and interpret a record of their on-the-move selves was a dramatic, technical re-mediation of their everyday activity and an invitation to engage in novel forms of spatial literacy and activity. We expected that looking at and talking about this record would further support the idea that representations—even paths captured by "God's Perfect Sight," a meaning for GPS used ironically by geographers—were partial and selective accounts of daily life through the urban terrain. During the analysis of personal time geography, youth were asked to publicly make sense of their movement over time, captured from a perspective they had never literally experienced (i.e., entire days, seen from ± 15,000 feet above the surface of the earth). Displacing personal experience into spatial forms (e.g., track layers over aerial photographs) provided youth with a new way to experience the relation between their lived world and cartographic representations of human activity.

The entire analysis of personal time geography session lasted forty-two minutes and was introduced by Kris as, "We're going to be looking at where you've been, so we're gonna be all up in your business." Displayed as continuous lines by the software, the track points were layered over the top of a scalable, satellite image of the city. These were projected on a screen at the front of the computer lab. While this display was novel for participating youth (and for the Workshop adults), we expected a densely detailed record of place over time would provide rich materials for exploring the relation between personal experience on-the-move (e.g., riding around a city park) and a more synoptic, map-like view of how those activities fit into the scale of the neighborhood and surrounding city. We also expected the activity to provide a novel setting for telling stories about youth activity. Since narratives are built crucially out of events unfolding through time (Labov 1972), the daily round—displayed as a temporally sequenced route (or path) consisting of all points gathered by a GPS device—presented participants with a novel invitation to construct narratives in both time and space. Youth engaged the activity with great interest, though critical reactions by peers also presented challenges to storytellers regarding who they were, in relation to the environment and to onlookers.

Of the six participants, five youth returned track records, with Fred refusing to use the device after his grandmother suggested the police would have access to resulting data.[6] William and Wallace collected the most track points (3,181 and 2,298, respectively). Among participating girls, Carissa had the most track points (849) followed by Leah (668) and Beth (206).

We analyze the presentation of two brothers, William and Wallace. Theirs were the second and third sets of track data displayed in the session, and by comparison with the first display (Beth), their relatively massive sets of connected points provided a stark visual contrast of youth mobility on bicycles. We also selected the brothers for close analysis because their track data sparked a playful discussion about discrepancies between mobility patterns displayed on the screen and their claim to have "stayed together the whole time" while carrying GPS devices. Playful peer criticism of stories told about the daily round involved new forms of spatial literacy as well as delicate aspects of identity work.

4.2.1 Recording, Displacing, and Reclaiming Bodies in Motion

We viewed track data, displayed over an official map of city neighborhoods, as a displacement of lived experience for participating youth. The track display simultaneously captured much *less* than their experience of the neighborhood (e.g., locations over time provided no information about places desired or avoided by participating youth), but also much *more* about their comings and goings than would typically be available to memory or in stories told of past time activity. As we show, youth made sense of these track displays by re-inserting lived bodies into narratives that spanned multiple scales of the daily round and stood up to concerns with recovering "the truth." These narratives were often co-constructed (Middleton and Edwards 1990), layering together the presenter's selective memories of recent days with shared, sense-making efforts to build plausible storylines for traces of personal mobility shown on the screen. Analyzing one's personal time geography placed the technical capabilities of the devices (and their users) in tension with the possibility of being perceived either as a person who did not get out much or as a couple of "busy bodies" (Carissa's assessment of William and Wallace in the excerpt, below).

By comparison with other participants, William and Wallace's track data were visually stunning when displayed in Google Earth™ (see Fig. 4), with paths tracing over twenty miles of urban terrain. Once Wallace's tracks were displayed alongside William's, track lines shown for one but not the other were noticed quickly and discussed by peers. While the brothers clearly were adept at using the devices (and creative, as we discuss later), their capacity for turning so many GPS track lines into a coherent *story* of the last five days was another matter.

At William's suggestion, Kris colored the brothers' track lines red and white. Displayed over a greenish satellite image, the red and white lines made it easy to see where their paths diverged. The moving bodies of two teenage brothers across a seamless photograph of the city quickly became a topic of conversation.

Excerpt 4: Discrepancies between showing and telling about moving bodies

1	Kris:	Alright, so, William is white and Wallace is red.
2	Wallace:	((*softly, smiling*)) How did I go around there?
3	Kris:	So Wallace, you didn't go as many places as William?

---

[6] Our study protocol, signed by all participants and their parents or guardians, clearly ruled out this possibility.

Table e continued

4	Wallace:	Um…
5	William:	Maybe the track thing just wasn't working.
6	Wallace:	Yeah, there's-
7	Kris:	It coulda not worked.
8	Wallace:	It says, it- We were in the same car when we went to the movies, but [it says-
9	William:	[Yeah, we stayed together the whole time.
10	Wallace:	I went around this way, and he went around this way. ((*points at screen, traces two paths*))
11	Kris:	So there's this over here, and then there's this over here. ((*cursor traces different red then white track lines to movies*))
12	William:	Yeah, I went both ways some how, and he only went one
13	Kris:	Hm-hm.
14	Carissa:	Yeah, that's a little strange.
15	Leah:	((*laughing*))
16	William:	Even though [the whole time we were- We were together the whole time.
17	Carissa:	[They were in the same car.
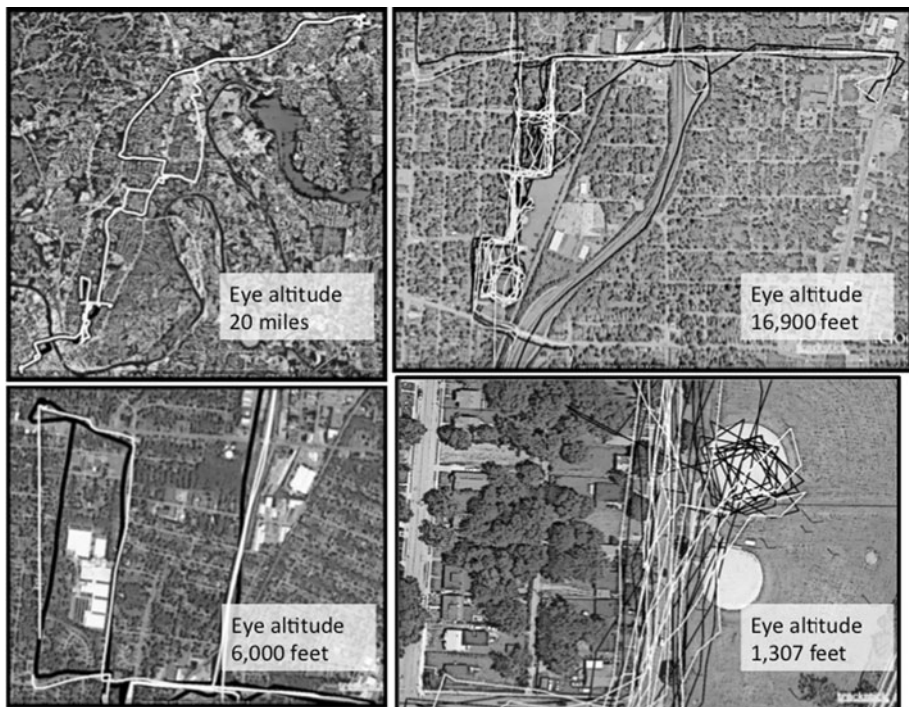
Fig. 4 William and Wallace's GPS tracks displayed in Google Earth[TM] at different eye altitudes

Represented as traces over a seamless, aerial photograph, the brothers' physical similarities (e.g., dreadlocks, huge smiles) and differences (e.g., William is skinny and Wallace is not) were invisible. The rich, connected histories of these two bodies as brothers,

traveling through life side-by-side, could be restored only through considerable spatial and narrative work. Particularly where color-coded paths diverged, an alternate narrative reality for stories about brothers as avatar-like characters opened up in conversation. GPS routes, satellite imagery, multi-party talk, and gestures linking talk to the display screen were layered together to tell what apparently happened, but also to account for the character or identity of the brothers as young people.

Wallace stared with a surprised smile at the tangle of red and white lines before him. Puzzled by an apparent discrepancy in the display, he asked softly, "How did I go around there?" (Turn 2). As the conversation unfolded, it became clear that at this map scale—an "eye altitude" (a Google Earth^{TM} term) of 20 miles above the surface of the earth—Wallace recognized a car trip he had taken with his brother to the movies. However, GPS track data showed diverging paths for what appeared to be segments of the return trip (Turns 10 and 11). Wallace's body had apparently done something he did not remember, and this was typical of many youth participants in this session. Track paths as a record of the daily round held an uncertain relation to memory for or storytelling about personal experience. Kris also saw the discrepancy (Turn 3), as did Carissa and Leah (Turns 14 and 15). Perhaps in defense of his brother's credibility, William proposed the "track thing" (GPS device) might not have been working. With some laughter, the brothers and Kris arrived at what might be a satisfactory explanation. What the GPS device "says" (Wallace animated the device as a party to the storyline) was probably a technical error, when compared with the brothers' assertion that "they were together the whole time" (Turn 16).

One way to account for discrepancies when producing a spatial narrative was device error, and indeed, youth participants in our study often experienced situations where the location shown by a GPS device did not match either the current or remembered location of their bodies. As a consequence, they began to question what these devices *said* as being at odds with their experiences, actions, and perceptions in the world. As they came to understand technologies for mapping more fully, they also began to question what was shown (and not shown) on maps. For example, while building layers of desired attributes (like Carissa's bicycle lanes at the beginning of this article), the brothers puzzled over polygons shown in Google Maps^{TM} of the area around their school, eventually discovering that these were outlines of a housing project that had been torn down years before our study began. Questioning the veracity or completeness of official maps and mapping tools, by comparison with what youth perceived or experienced on a daily basis, contributed to emerging practices of counter-mapping as our study progressed.

4.2.2 Finding Mobility Patterns by Zooming Across Scales

Participants also made sense of their daily round by telling spatial stories across different scales of the urban terrain. Youth were quick to understand and use the "zooming" function of the software to reveal patterns at different scales within their tracks. Constructing a narrative across scales led youth to ask questions about what was visible at one eye altitude and then drill down to find answers at closer eye altitudes. Changing spatial scales was particularly useful with William and Wallace's track data, since they had a few trips far from home and then much more compressed mobility within their neighborhood. At higher eye altitudes (e.g., 20 miles up), the red and white tracks followed roads across dozens of miles of the urban terrain. At lower eye altitudes, between 1,000 and 17,000 feet, track lines were more elaborately tangled, following residential streets, visiting familiar homes, and tracing circles in neighborhood parks (Fig. 4).

From roughly twenty miles up in the sky, the projected image showed the brothers' tracks crossing a river, spanning the city from the west to the east, following a major interstate north, and ending-up in an entirely different city. But Wallace also noticed "a cluster" of activity that looked interesting to him closer to home (Turn 18, below).

Excerpt 4 continued: Zooming to find new mobility patterns

18	Wallace:	What about [that little cluster, right there. ((*pointing at screen*))
19	Carissa:	[Apparently not. Someone's lying. ((*news anchor voice*))
20	Leah:	((*laughing*))
21	Kris:	This one here?
22	Wallace:	Yes.
23	Kris:	Wanna take a look at it? [Zoom in? ((*pans and zooms in on large rectangle*))
24	Wallace:	[Yes. Oh, that's when I drove all the way around, all- on my bike you know. [I went all the way around there. ((*laughing*))
25	Carissa:	[Man, you all are some busy bodies. (What were you doing with) all those li::nes?
26	Kris:	Where did you- you rode on your bike? Show [me where you rode on your bike
27	Wallace:	[That big rectangle at the top.
28	Kris:	Up here?
29	Wallace:	I rode my bike all the way around there.
30	William:	You did?
31	Carissa:	((*to William*)) So did you, apparently
32	William:	((*to Carissa*)) No, I didn't.
33	Wallace:	Oh, wait, no, no, no. It might have been the other way around.
34	Leah:	I was gonna to say, 'cause that's pretty far.

As Kris reached a closer eye altitude with the zoom function, Wallace began a new narrative about riding his bicycle "all the way around" a multi-block rectangle that emerged out of the cluster of track points (Turn 24). At this altitude, on-the-ground activities on foot or bike were visible in more detail. Thin gray lines were recognizable as neighborhood streets, large green spaces could easily be parks, and a grid pattern emerged. While the higher altitude scale showed multiple cities, this scale showed *areas* of the city, including several different Woodbridge neighborhoods. At the scale of neighborhood areas, the boys' tracks looked like knots of string littering the streets and a park.

Kris asked for more information about Wallace's bicycle riding (Turn 26), even as his story about riding a newly visible rectangle came under critical scrutiny by Carissa and Leah. Carissa began what sounded like a news report of false testimony (Turn 19), and then upon closer viewing, she positioned the brothers as "busy bodies" (Turn 25), given their tangle of track lines on the map. Following on, Leah wondered (Turn 34) if the trip was even possible on a bicycle. Even William, who corroborated his brother's account of riding together in a car earlier during the presentation, wondered about riding the rectangle (Turn 30). But Carissa was not ready to let him separate from his brother's possibly exaggerated story of bicycle mobility (Turn 31). Despite the girls' joking skepticism, the rectangle claimed by Wallace was only 2 miles in perimeter, while the safety ride completed by the entire group was 2.8 miles round trip.

As the conversation continued (Turns not shown), Wallace decided the "rectangle" was actually a car trip to a relative's house (Carissa and Leah's skepticism was confirmed). But

he again noticed a cluster of points (Turn 1, below; bottom right image in Fig. 4), and after Kris zoomed closer to the ground, Wallace described his plan to draw circles while riding around in a baseball field in the brothers' home neighborhood.

Excerpt 5: Drawing circles by riding the perimeter of a baseball field

1	Wallace:	Ok. What is all them clusters? ((*points, laughing*))
2	Kris:	How 'bout down here?
3	William:	That's where we live
4	Wallace:	Oh, [that's- I think that's when I was riding in circles
5	Leah:	[Um-hm::::
6	William:	Yeah, he was- he was mad, and I was (inaudible)
7	Wallace:	Oh, there, it's right there! Look
8	Kris:	Here?
9	Wallace:	Right—[go down.
10	William:	[Oh, that red s- cluster. He was riding [a little ball (on the baseball diamond)
11	Wallace:	[That's a little ball right there. I was riding in circles around the baseball field
12	William:	It was a baseball field.
13	Kris:	Do you [wanna- do you wanna come and point to it?
14	Leah:	[((*laughing*)) He [rode in a big circle.
15	William:	[That cluster
16	Carissa:	Oh, I [see.
17	Wallace:	[((*pointing, walking to computer*)) The red circle up there.
18	Kris:	Up here?
19	Leah:	That itty bitty circle.
20	William:	[He's riding in circles on the baseball field
21	Wallace:	[Yeh, right there. ((*standing by Kris at computer*))
22	Kris:	Oh, so you went around- ((*traces William's locations on side of field*)) William was like, I'm just gonna hang out over here, and you just went crazy around here? ((*traces Wallace's lines around baseball field*))
23	Wallace:	Yeah.
24	Kris:	Cool.
25	Carissa:	And then he got angry.

At this still closer eye altitude (1,307 feet, bottom right image in Fig. 4), a baseball field in the brothers' neighborhood was clearly visible, and there was no question that Wallace had set out to do something creative with his new bike and a GPS tracking device. As the conversation continued (Turns not shown), he and William also shared a shape they created by riding the perimeter of a running track, and they described other neighborhood activities like attending Vacation Bible School. In spite of their earnest pleasure in sharing their time together with new bikes, the girls continued with assessments that were humorously dismissive of the boys' creative efforts with a new means of mobility (Turns 5, 14, 16 and 25). As the brothers' presentation of personal time geography ended (also not shown), concerns about the boys riding on the interstate were resolved by checking speeds listed with each track point, leading to a discovery (with great hilarity) that their aunt was guilty of speeding while driving them to the movies.

Analysis of personal time geography inverted the relation between doing and repre-
senting that youth experienced during the safety ride as a form of ground-truthing. While
riding in the city provided a way to discover problems with standard representations of the
urban environment (i.e., traffic maps), zooming in and out of traces of one's activities in
the analysis of personal time geography provided youth with a chance to see their activity
from a novel perspective both in space (i.e., from one half to twenty miles above the
surface of the earth) and in time (i.e., tracks were sequenced over as many as 5 days of
activity). Making sense of the tension between the experience of one's daily round in city
neighborhoods and a cartographic representation of that activity again provided youth with
material for thinking about the adequacy of map-based representations and the layout of
the city for their sensuous activities (e.g., playfully inscribing circles and rectangles by
riding around neighborhood parks).

But telling the daily round in this novel representational form also led to playful
criticisms of youth presenting their activities to peers. For William and Wallace (similarly
for other youth presenting their track data layers), what they remembered as pleasurable
movement on new bicycles could also be held up for public scrutiny as exaggerated or
perhaps even fabricated stories from a couple of "busy bodies." While we designed the
analysis of personal time geography activity to make relations between lived activity and
representations of that activity in the city visible, we found this activity also invited critical
yet playful forms of identity work. Making sense of the daily round from 20 miles up in the
air involved new forms of spatial thinking—zooming, unpacking clusters to find mobility
patterns, and creating plausible stories about activities that could produce these records.
This required that youth recover their own and others' bodies in representations that were
dramatic abstractions from everyday life. Youth struggled to restore experiences with
friends and family, in cars and on bikes, in movie theaters and on the baseball field, to
create new spatial and temporal perspectives on familiar activity in their neighborhoods.

5 Discussion

We started this article with an example of counter-mapping, in which a teenage girl argued
for new means of access to cultural resources in her city through a network of bicycle
lanes. Her desires were framed both on behalf of her present time neighbors—people
walking or biking to community parks and shopping—and on behalf of herself in an
imagined future, with an expanded range of possibilities as a young adult. While Carissa
lived and attended school in a city with a long history of racial and economic segregation,
her critical engagement in counter-mapping focused primarily on a lack of provision for
elective, youth, and resident activity. Unlike the explicitly critical, historical perspective of
many adult participants in planning processes we studied, Carissa's desires to move across
neighborhoods typically seen as separate (e.g., from the university to the music recording
area of town) were oriented to the future and distinctly hopeful. Her desires undoubtedly
reflected a multitude of experiences in the city, but Carissa's focus on access to community
assets and transportation independence from cars was, we argue, a response to her par-
ticipation in our design experiment. Carissa's facility with showing and talking about what
she did and wanted to do in the city were also observed, with varying degrees of articu-
lation, for all of the youth participants in our study. Though limited in scope, we see this
design study as the development of a youth-oriented practice of counter-mapping that
involves spatial literacies, and serves new forms of civic engagement. Still under devel-
opment as our study came to an end, the fledgling practices of counter-mapping we created

with youth participants were consistent with Harvey's (2008) observation that in making or imagining the city, we are also making and imagining ourselves.

Since our analysis worked backwards from Carissa's presentation of her desire layer for the Woodbridge neighborhood, we briefly review the designed activities leading up to her discursive performance and then summarize findings related to our leading questions. We knew about the history of the Woodbridge neighborhood from our earlier study of public participation in city planning. In that study, older residents took a critical, retrospective view of how the city and economic forces dismantled their once vibrant, middle class neighborhoods. Adults partly blamed city officials (e.g., dividing the neighborhood with an interstate), but they also remembered families moving out of the neighborhood as pressures on residential segregation in the city eased. For most adult residents who remained, the neighborhood was seen as both a food and a transportation desert.

We started out to reverse the nearly complete absence of youth perspectives or voices in planning. We designed activities and novel uses of technology that, we thought, would engage neighborhood youth in new ways of experiencing, thinking about, and using urban spaces in and around their neighborhood. These activities included making and using maps of existing neighborhood spaces, building and using a bicycle to experience a broader range of elective mobility in the neighborhood, using location-aware technologies to capture and analyze personal mobility in the neighborhood over time (i.e., GPS tracking), and using map-making tools that would allow youth to create and present their desires for the neighborhood in the future.

Our analysis looked closely at selections from two phases of these designed activities. In the first, we considered what youth experienced and later remarked on as surprising about their first attempt to ride bikes together in the city. Since riding together (or a part) was a new form of mobility for youth, our analysis initially focused on how riding formations were created and maintained through time and over space. This involved significant adult scaffolding to support youth safety, and there was clear evidence both that youth struggled to operate their new bikes and that riding on a street grid with other vehicles presented significant challenges. While there was ample evidence that experiences along the ride were intense for youth, we hoped these experiences would provide material for thinking about mobility on bicycles for the remainder of the study. In a debrief interview while cooling down after the safety ride, youth related vivid (for some, terrifying) experiences along the safety ride, evident in the way they used gesture and body stance to re-enact efforts to pass safely through a city intersection. But these experiences, we argue, were not just about a particular bus or moment of terror.

When questioned further (again, adult scaffolding was important), youth talked through a comparison of routes that were safe for riding but indirect ("weaving in and out and stuff") and those that were busy but provided access to desirable things ("go everywhere important"). These same tradeoffs were found in the desire layers created by youth later in the study (e.g., Carissa's bike path to neighborhood gardens) and reflected a new awareness of the kinds of routes that would support independent bike riding in the city. This emerging, youth orientation towards mobility and access to the city also resembled exchanges between planners and more persistent residents during conversations about new developments in Woodbridge. In this sense, our desire to engage youth in activities that would lead them to speak in ways that planners would recognize was at least partly successful.

We also looked closely at an activity in which youth used mapping tools to analyze their personal mobility, captured with wearable GPS devices and made visible as tracks tangled over scalable, commercial maps of the city. These activities, we argued, provided youth

with a chance to further explore relations between lived and represented space, crucially including the ability to assemble movement through time (i.e., weeks of activity) over a common spatial surface. While the safety ride provided an opportunity to reflect on a single traversal in the city on bikes, the analysis of personal time geography allowed youth to consider what was typical about their everyday activities, and how their possibilities for elective mobility had changed with a new bicycle. As our descriptive analysis showed, telling stories about the daily round required the negotiation of multiple perspectives on meaningful activity, scalable not only in time and physical space (e.g., telling about evident discrepancies in track data during a trip to the movies) but also in social space (e.g., Carissa's skeptical stance towards the brothers' accounts of their activities together as "busy bodies").

These activities were designed to provide material for what we hoped would become a broader, critical discursive (thirdspace) practice of counter-mapping. Indeed, experiences and new understandings created during these activities (e.g., discussing tradeoffs for different bike paths, exploring a more expansive daily round on bicycles) were carried forward into map-building activities, when youth used web-based mapping tools to create "desire layers" for future activity in the city. As illustrated in Carissa's proposal for bike lanes, youth were able to make sense of and use comparisons of different forms of mobility (walking, biking, and being driven) and different perspectives on their daily round (from doing mobility in ground-truthing to seeing and comparing different patterns of mobility in the analysis of personal time geography session). This sense-making was a joint accomplishment, requiring sustained engagement with different ways of experiencing, representing, and reflecting on mobility in the city. As the design study progressed, youth thought of and talked about their neighborhoods and the city in new ways; they thought about Woodbridge as a place for bicycle lanes, about personal mobility as access to cultural assets, and about representational technologies (e.g., GPS devices) as fallible and maps as both incomplete and extensible. These new forms of sense-making and engagement with geospatial technologies culminated in the construction and presentation of map layers reflecting youth desires that were both practical and fanciful.

While there is not room in this article to follow the trajectory of youth counter-maps forward in the city, we did arrange several venues in which they presented their work to city planners and other representatives of the city government. This broader circulation of youth counter-maps was possible for several, related reasons. First, the Workshop in which we conducted the study was increasingly visible in the local press, and Cecil (our community partner) became something of a local celebrity, asked to contribute in a push by the City Mayor's Office to redesign the downtown transportation grid to move towards a healthier urban environment. At the same time, ongoing relations with urban planners, that started during our ethnographic study of participatory planning, helped to make our design study at the Workshop visible in other areas of city government. Both we and city planners pushed to create opportunities for youth to present their maps and spatial arguments to other stakeholders, including representatives of the Mayor's Office and consultants they had hired to re-design bike lanes in City neighborhoods.

As we analyzed and began writing about our design experiment, study activities "leaked" into the surrounding community in ways we had not anticipated. The route chosen by Carissa, William, and their peers was independently built, named, and published in a bike map contracted by the Mayor's office, including other routes ridden or proposed by youth in our study (as well as by Cecil). Regional transportation planners, whom we invited to serve as an audience for youth counter-maps, adopted our methods of gathering GPS tracks and using time diaries to conduct larger scale surveys with households in a

surrounding, five-county planning study area (Katie's household participated in that survey). Similarly, urban planners opened their next round of participatory planning by facilitating youth design charettes at three local high schools, and this approach to youth involvement in planning is now a central part of an effort to create a 25 year plan for the City (Katie helps coordinate youth participation in the plan). While the diffusion of our work (and that of many others) into the community required interest and deliberate effort from many different stakeholders, we feel it is reasonable to argue that substantial learning occurred also at a collective or social level of analysis. We hope to keep this flow of changes in spatial literacy and activity moving, organized around a model of youth counter-mapping that can be further refined through expanded use.

We conclude with an account of an exchange between youth participants in our study and a cartographic consultant, who was hired by the Mayor's Office. This consultant was hired to create a biking map for the City similar to designs he created for bike-friendly maps of cities across the United States. After listening to Carissa and the brothers describe how they created desire layers based on their new experience of biking in the city, the consultant and his team commented on how similar their own work was to what youth had described. As he put it to youth in our study,

> Like sometimes you have all these experts running around with fancy words and fancy plans, and what you guys were doing was way beyond that. Nothing beats getting your feet dirty and your hands dirty and getting into the mud, finding out what's there in person, and just reacting to it. And that is, really, the highest science (Bob Firth, personal communication).

References

Cobb, P., Confrey, J., Disessa, A., Lehrer, R., & Schauble, L. (2003). Design experiments in educational research. *Educational Researcher, 32*(1), 9.

Cole, M., & Griffin, P. (1983). A socio-historical approach to re-mediation. *Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 5*(4), 69–74.

Dennis, S. F. (2006). Prospects for qualitative GIS at the intersection of youth development and participatory urban planning. *Environment and Planning A, 38*(11), 2039–2054.

Derry, S. J., Pea, R., Barron, B., Engle, R., Erickson, F., Goldman, R., et al. (2010). Conducting video research in the learning sciences: Guidance on selection, analysis, technology, and ethics. *Journal of the Learning Sciences, 19*, 1–51.

Gutierrez, K., & Vossoughi, S. (2010). Lifting off the ground to return anew: Mediated praxis, transformative learning, and social design experiments. *Journal of Teacher Education, 61*(1–2), 100–117.

Hägerstrand, T. (1970). What about people in regional science? *Papers in Regional Science, 24*(1), 6–21.

Hall, R. & Greeno, J. G. (2008). Conceptual learning. In T. Good (Ed.), *21st Century Education: A Reference Handbook,* (pp. 212–221). Sage.

Hall, R. & Leander, K. M. (2010). Comparative analyses of spatial thinking in diverse professional practices. *Paper presented at the American Educational Research Association Annual Meeting*, Denver.

Harding, S. (1993). Rethinking standpoint epistemology: What is "strong objectivity"? In L. Alcoff & E. Potter (Eds.), *Feminist epistemologies* (pp. 49–82). New York: Routledge.

Hart, R. (1977). *Children's experience of place*. New York, NY: Irvington.

Harvey, D. (2008). The right to the city. *The New Left Review, 53*, 23–40.

Holloway, S. L., & Valentine, G. (Eds.). (2000). *Children's geographies: Playing, living, learning*. New York, NY: Routledge.

Jordan, B., & Henderson, A. (1995). Interaction analysis: Foundations and practice. *The Journal of the Learning Sciences, 4*(1), 39–103.

Karsten, L. (2005). It all used to be better? Different generations on continuity and change in urban children's daily use of space. *Children's Geographies, 3*, 275–290.

Kingston, R. (2007). Public participation in local policy decision-making: The role of web-based mapping. *The Cartographic Journal, 4*(2), 138–144.

Kwan, M. (2004). Beyond difference: From canonical geography to hybrid geographies. *Annals of the Association of American Geographers, 94*(4), 756–763.

Labov, W. (1972). The transformation of experience in narrative syntax. In W. Labov (Ed.), *Language in the inner city* (pp. 354–396). Philadelphia, PA: University of Philadelphia Press.

Lauriault, T. P., & Wood, J. (2009). GPS tracings—Personal cartographies. *The Cartographic Journal, 46*(4), 360–365.

Leander, K. M., Phillips, N. C., & Taylor, K. H. (2010). The changing social spaces of learning: Mapping new mobilities. *Review of Research in Education, 34*, 329–394.

Lee, V. R., & DuMont, M. (2010). An exploration into how physical activity data-recording devices could be used in computer-supported data investigations. *International Journal of Computers for Mathematical Learning, 15*(3), 167–189. doi:10/1007/s10758-010-9172-8.

Lefebvre, H. (1996). *Writings on Cities (E. Kofman & E. Lebas, Trans.)*. Malden, MA: Blackwell Publishers.

Middleton, D., & Edwards, D. (1990). *Collective remembering: Inquiries in social construction*. Thousand Oaks, CA: Sage Publications.

Moje, E. B., Ciechanowski, K. M., Kramer, K., Ellis, L., Carillo, R., & Collazo, T. (2004). Working toward third space in content area literacy: An examination of everyday funds of knowledge and discourse. *Reading Research Quarterly, 39*, 38–70.

National Research Council. (2006). *Learning to think spatially*. Washington, D.C.: The National Academies Press.

Norris, S. (2004). *Analyzing multimodal interaction: A methodological framework*. New York, NY: Routledge.

Peluso, N. L. (2005). Whose woods are these? Counter-mapping forest territories in Kalimantan, Indonesia. In M. Edelman (Ed.), *The anthropology of development and globalization: From classical political economy to contemporary neoliberalism* (pp. 273–281). New York, NY: Wiley-Blackwell.

Pickle, J. (Ed.). (1995). *Ground truth: The social implications of geographic information systems*. New York, NY: Guilford Press.

Sanoff, H. (2000). *Community participation methods in design and planning*. New York: John Wiley & Sons.

Santo, C. A., Ferguson, N., & Trippel, A. (2010). Engaging urban youth through technology: The youth neighborhood mapping initiative. *Journal of Planning Education and Research, 30*(1), 52–65.

Schegloff, E. (1992). Repair after next turn: The last structurally provided defense of intersubjectivity in conversation. *American Journal of Sociology, 97*(5), 1295–1345.

Soja, E. (2010). *Seeking spatial justice*. Minneapolis, MN: University of Minnesota Press.

Streeck, J., Goodwin, C., & Lebaron, C. (Eds.). (2011). *Multimodality and human activity: Research on human behavior*. New York, NY: Cambridge University Press.

Taylor, K.H. & Hall, R. (2011, February). Forming publics: Negotiating what develops at the interface of participatory planning. Paper presented at the 32nd Annual Ethnography in Education Research Forum, University of Pennsylvania.

Wood, D., Fels, J., & Krygier, J. (2010). *Rethinking the power of maps*. New York, NY: Guilford Press.