WAYFINDING IN NEW YORK CITY:

AN INTEGRATED APPROACH TO SPATIAL COGNITION

by

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Abstract

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This study has two objectives. First, to describe the process by which adults get to know and use a large-scale environment. Second, to support my hypotheses that wayfinding consists of a repertoire of evolving processes and strategies, including internalized representations of space, situated actions, and use of the environment.

The current study expands on integrative perspectives to spatial cognition that consider the individual as an embodied mind and suggest continuity between the internal cognitive processing of information and the physical world. In the cognitive and environmental psychology literature, symbolic representation theorists often ignore the role of the environment in spatial cognition. On the other hand, action/activity approaches focus too much on the external physical world while often leaving internal symbolic processes unexamined. This dissertation integrates elements of both activity and cognitive representation theories, examines the relationship between them, and suggests that people

moving through cities can be understood as action systems configured by a mind, a body, and the environment.

In this dissertation, I employ qualitative methods to (1) study spatial behavior and environmental adaptation to the city, and (2) describe wayfinding through its related cognitive representational processes, purposeful spatial activity, and the physical elements of the city. These methods include in-depth walk-along interviews, detailed commentary notes, and maps/sketches by participants.

Results from my qualitative analysis indicate that Manhattan is spatially organized in three layers: underground (subway system), street level, and a more subjective level I have called "bird's-eye." The findings support my hypothesis that wayfinding consists of a repertoire of strategies, configured both by internalized representations of space and situated actions. My results also indicate that the use and selection of representation-action cognitive strategies of this repertoire (1) depend on environmental "channeling," and (2) change over time.

This study contributes to the literature on spatial cognition in three ways. First, it expands upon current knowledge of spatial cognition by providing detailed research on the process by which adults get to know and use New York City. Second, it demonstrates that wayfinding consists of a repertoire of strategies. Third, it shows that an integrated theoretical and methodological approach is the most useful for understanding the dynamics of spatial cognition, especially in relation to how newcomers to a large city learn how to navigate new locations.

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GLOSSARY

Action system - An active system configured by three connected components: a mind, a body, and the environment. The system is an "en-worlded," embodied, mind (e.g., Clark, 1996; Varela, 1993).

Cognitive map - Mental construct that we use to understand and know the environment (Kaplan, 1973). "It enables a person to predict the environment which is too large to be perceived at once, and to establish a matrix of environmental experience into which a new experience can be integrated." (Stea and Blaunt, 1973, p. 227). Cognitive maps involve the integration of images, information, and attitudes about an environment." (Spancer and Blades, 1986 p. 240). They are complex, highly selective, abstract, and generalized structures, which are incomplete, distorted, schematized, and augmented." (Downs & Stea, 1973*b*, p.18)

Cruising - The development of wayfinding into waydoing goes through a transitional stage called "cruising." Cruising is more embodied and automatic than wayfinding but involves some degree of internal cognitive processing (correcting a mistake in the plan, for example) when walking a route.

Situated Activity - A group of behaviors that occur linked to space and that imply situated decision-making. This notion stems from Suchman's definition and integrates the Gibsonian concept of affordances.

Sketch map - A cognitive map represented (drawn/sketched) on paper.

Spatial cognition - In this study, spatial cognition refers to internal symbolic processes by which people get to know space and which are employed to aid navigation. Hart and Moore (1073) define it as "... the knowledge and internal or cognitive representation of the structure, entities, and relations of space; in other words, the internalized reflection and reconstruction of space in thought." (p. 248)

Spatial map - Template that an individual has of a city at any given time. Spatial maps evolve and change and develop mainly from generalizations of other cities' maps, experience in a city, actual maps and other spatial indirect information.

Waydoing - Navigational behavior that occurs when cognitive structures give way to a more embodied, less attentive behavior in space. Waydoing consists on two distinct modes: cruising and autopilot mode.

Wayfinding - The ability to relocate from one place to another in a large-scale environment (Blades, 1991). Wayfinding consists of the purposeful activity and decision-making involved with getting to a destination, when a route or segment of a route needs to be "figured out."

CHAPTER I

INTRODUCTION

The rise of the global economy has led to increased travel between nations, city centers, and rural areas. Mass migrations from poor to prosperous nations have brought about population shifts, as employers and workers have sought opportunities in new locations. Yet the design of cities, the layout of signage, systems of transportation (pedestrian, public, and automobile) and city plans have not transformed in pace with these changes in use.

It is clear that many environmental transitions (moving from one city to another, for example) are stressful and unsettling, but eventually lead to adaptation. While the symptoms and outcomes are clear, the processes involved are not. This dissertation addresses the relationship between environmental design, activity, and spatial cognitive representation as they affect these adaptive processes. It is hoped that the findings of this study may be generalized and will contribute to theory and design that will help ease often-difficult environmental transitions.

Literature on spatial cognition presents two clearly different objects of study (symbolic cognitive processes and situated activities) and methodologies (cognitive maps and behaviors, respectively). My claim is that by being mutually

exclusive in principle these approaches fail to consider and properly describe the multiplicity of processes and structures involved in the cognition of space. My findings point out that an integrated approach, involving the relevance of symbolic processes and environmental structures, is the optimal approach for understanding spatial cognition.

This study has two general objectives. The first is to describe the process by which adults get to know and use a large-scale environment (New York City). This is accomplished by studying the procedures and structures that play a role in wayfinding. Second, to explore two hypotheses: (1) that wayfinding consists of a repertoire of strategies, ranging from internalized representations of space to situated actions, and (2) that these strategies and their interaction change by virtue of time and spatial channeling.

The integrated cognitive-environmental theoretical approach that guides this dissertation stems from a recent controversy concerning the development of spatial knowledge. One school of thought focuses on the development of spatial knowledge as the development of symbolic spatial representations – the formation of mental maps. This point of view is associated with mainstream spatial cognitive psychology, greatly influenced by Piaget and Inhelder's (1956) work in developmental spatial cognition. Such theorists focus mainly upon the processing structures of the brain and the symbolic representations of the mind. According to this view, all activities regarding spatial cognition occur internally, yielding to a

natural distinction between "out there" and the processes inside. While proponents of this theory acknowledge that activities take place in certain environments, they suggest that cognitive processes "representationally." Therefore, in this view, it is important to understand an individual's internal processes and the nature of his/her input-output transformations.

A different point of view focuses on the situated character of action, which makes representations a poor approximation at best of the complexities of spatial knowing. From this point of view spatial knowledge involves a complex interweaving of knowledge as representation, as well as constraints and supports for activity provided by the environment in its physical and communicative structure (as for example a street sign).

Following this line of thought, Suchman (1993) calls into question the relevance of the concept of cognition. Her approach departs from a common-sense view of action (action is her focus, not cognition), in which activity, even the most analytic, is fundamentally concrete and embodied. According to Suchman, even planned, purposeful actions are situated actions (taken in the context of concrete situations), since the circumstances of our actions are never fully anticipated and are continuously changing around us. For Suchman, plans are situated actions, not cognitive processes.

The situated activity approach focuses on the structures of the world and how they constrain and guide human behavior. Human knowledge and interaction

cannot be divorced from the world; to do so is to study a disembodied intelligence. What really matters is the situation and the parts people play. One cannot look at just the person, environment, or situation, since the phenomenon is a mutual accommodation of person and environment. This literature tends to emphasize historical influences, social interactions, culture and the environment, and minimizes the importance of internal cognitive processes. It claims that the symbolic approach presents a disembodied mind.

My own reading of the literature suggests an intermediate, integrated position. I think that action/activity theorists focus too much on the external physical world, leaving the internal symbolic processes unexamined. On the other hand, the symbolic representation theorists leave the behaviors of the acting subject too much out of theoretical focus. Concretely, I suggest that spatial cognition involves internal cognitive processes, environmental structures, and all the situated actions (by the individual) that tie them together.

Although I identify more strongly with the situated activity approach, I recognize valid arguments in the symbolic approach. I suggest that it is not fully correct to say that situated actions are not carried out symbolically. I believe that some actions can be carried out with no conscious awareness of the intermediate links, but others cannot, and this depends upon other factors such as familiarity or expertise. For example, when a space is known, many physical elements "disappear" from our consciousness. We do not need to pay attention to them on

order to navigate, so we stop being aware of them (a building as a landmark, for example). The internal representation of these physical elements is no longer relevant for wayfinding since we are no longer consciously solving a problem or planning; we are simply doing it (getting to a destination in a familiar environment, for example). But some activities require information processing in the first place, specially in environments that are being experienced for the first or first few times (wayfinding in a new city, for example).

My perspective builds on Clark's (1980) approach, which shaped my understanding of the connection between the internal processes and the external world. Internal processes and the world are bound by an active body (as *"sensory-enactor"*) and manifest in actions or activity. From Clark's perspective, brains evolve as controllers and integrated parts of bodies, moving and acting in the real world. Thus symbolic resources are complementary to the actions they control and the external environment becomes a key extension to our embodied mind (Varela et. al., 1991).

In the last four years of my research in spatial cognition, I have used Clark's theoretical position as a standpoint when focusing on activity and the use of the environment in spatial cognition. I have studied the different ways in which people wayfind, become oriented, and navigate through New York City, including the subway system as well as the network of streets and buildings. In my initial attempts to study spatial cognition, I confronted some of the limitations of the

cognitive methodologies by trying to assess the internal processes, either through cognitive maps alone or by asking people to talk about their through processes while wayfinding. Through this research, I realized the obvious: nobody has access to somebody else's mind. The situated activity approach helped me solve this methodological limitation by focusing on the person's continuous interactions with the environment. I observed and talked to people as they actively tried to find their way to different destinations within the subway system of New York City.

The current study is a continuation of my previous research in the area of purposeful spatial behavior -- or wayfinding. I have extrapolated my prior findings and theoretical approach to New York City's street level in the area of Midtown Manhattan, and have used wayfinding as a case to support that the best way of conceptualizing spatial cognition is an integrated view that considers cognitive structures and situated actions. My theoretical claim calls for an integrated methodology constituted by a battery of methods that addressed each of the multiple dimensions of wayfinding as a case of spatial cognition.

To study the way newcomers develop knowledge of the city and how their use of space changes over time, I used three qualitative techniques: open-ended walk-along interviews (including "free-navigation" and a wayfinding task), commentary notes I compiled of the interviews and walks, and maps/sketches drawn by participants. I interviewed people as we walked to different destinations

in the midtown and downtown areas of Manhattan. During those walks I tape-recorded my participants' speech regarding their thoughts about the wayfinding task. Simultaneously, I recorded my own observations of the participants' speech, behaviors and decision-making processes. Interviewing people as they wayfound provided me with plenty of information relating to what my participants were thinking (using a cognitive map, for example) and regarding their interactions with the environment (immediate decision-making such as taking a street because the walk-sign was on). Additionally, I collected maps sketched by participants of Manhattan and of the routes traveled and tape-recorded their descriptions as they were drawing the maps. These maps provided data on the elements that get to be internalized (personal landmarks such as a store, for example) as well as the cognitive processes and environmental structures that play a role in the internalization of information and its application to wayfinding. Variability in data (from interviews and maps) at different periods helped me identify and describe changes in the structures and processes related to knowing and using space through time.

I claim that previous research has failed to address spatial cognition adequately because it has focused only on specific and isolated aspects. Through my work, limitations of these previous methods are addressed and, in the process, the value of my methodological approach is demonstrated. This dissertation project brings together measures of activity and of representation so that their

relationship is directly examined. Qualitative research methods are applied to study spatial behavior and environmental adaptation to the city, as well as to assess cognitive representational processes and the physical elements represented either symbolically or in the constraints they pose in behavior.

My research results indicate that people's representation of Manhattan is spatially organized in three layers: underground (subway system and subway map), street level, and a more subjective level, which I have called "bird's-eye" view (a layer that provides an aerial view of specific familiar areas). The results also indicate the presence and development of different cognitive, situated and environmental structures and processes in wayfinding.

The findings of this study support my hypotheses that spatial cognition consists of a repertoire of strategies, including symbolic processes, situated actions, and environmental structures. The use of these strategies and processes changes over time and their interaction depends on the way spatial channels behavior. The findings also solve the theoretical and methodological limitations encountered in previous cognitive and environmental studies of spatial cognition.

CHAPTER II

THEORETICAL MILESTONES IN THE STUDY OF SPATIAL COGNITION

This study investigates the way newcomers get to know and use the city of New York in terms of environmental organization. The phenomenon is approached by studying the way people "wayfind" in the city and how wayfinding –a process that involves some degree of internalized processing of information– develops into a more situated, less conscious activity termed "waydoing."

In this chapter, cognitive representational theories relevant to the study of large-scale environments are reviewed on Section I. Theories that have underlined the importance of activity as the object of study in spatial cognition, including the more environmental, "external" approach to the study of the city, are described in Section II. Middle-ground perspectives that consider elements of both approaches in the study of spatial cognition are discussed on Section III. Finally, wayfinding as a case of spatial cognition is presented on Section IV.

In order to understand wayfinding, it is helpful to review some of the predominant theories of spatial cognition. The cognition of space has basically been studied from three different yet related theoretical standpoints. All three

focus on the relationship between environment and cognition, but they diverge in their focus of study. Cognitively oriented theories (e.g., Piaget and Inhelder, 1956; Cassirer, 1957; Siegel and White, 1975; Downs and Stea, 1973; Kitchin, 1994; Kaplan, 1976; Evans, 1980; Golledge, 1987; Garling, Lindberg, Carreiras, and Book, 1986; Appleyard, 1970; Wood, 1973; Hart and Cohen, 1991) focus on the internal representation of the environment. Environmental theorists focus on the elements of space that are significant in structuring the city (e.g., Lynch, 1960; Moeser, 1988; Devlin, 1976; Ferguson and Hegarty, 1994; Giraudo, Pilhous, 1994). A third group, of which I am an advocate, provides an integrated approach to studying spatial cognition. Such theorists focus on the value of activity and behavior as the link between the internal representations and the physical environment (e.g., Suchman, 1987; Gibson, 1979).

The theoretical contribution of my work suggests that an integrated approach to spatial cognition yields the greatest understanding of how people perceive, learn, and master a new physical environment (in this case New York City). The longitudinal nature of this dissertation describes how a process that involves some degree of representational activity (wayfinding) transforms into a situated one (waydoing). By delineating the processes by which these two activities occur, this dissertation adds to the theoretical debates on spatial cognition.

I. Representational aspects of spatial cognition

In representational theories to spatial cognition all thinking/knowing processes take place in an internal/central mind. From this perspective, as individuals move through space, they develop mental structures, known as "cognitive maps" that serve as a way of understanding the physical environment. This representational approach developed in opposition to behaviorist models because the former favor mental processes over "simple" observable behavior. By stressing that all the relevant processes occur inside the head, however, these theories artificially divide what happens inside the mind from the world. In essence, they disembody the mind and "disenworld" the body.

A. Traditional cognitive psychology: "Logic over space" theories

In cognitive psychology, there are three theorists who can be grouped together because of their pioneering interest in linking the subject with the world. These theorists assume that the individual's mental structures provide the basis for interpreting objects, actions, and events in the external environment. These structures guide the decisions and the actions of individuals in response to perceptions and interpretations of self and environment. Perhaps the most meaningful author on the specific topic of spatial cognition is Piaget, since he views the interaction between the subject and his physical environment as the main focus for studying development.

A relevant contribution of Piaget's theory is to suggest that in order to know objects, the subject must act upon them and transform them. In this way, knowledge arises from the interactions (transformations) between the subject and objects. According to Piaget (1956, 1969), a child gains experience and learns through acting and interacting in the world. The end result of these interactions is the development of an internal cognitive structure in each child. This structure allows abstract operations and knowledge, distant from embodied actions in the world. Considering that humans are intrinsically immersed in a physical context, a limitation of this approach is to suggest an increasing differentiation of the self and the environment.

Following the Kantian tradition, Piaget asserts that logic is prior to experience, but tries to account for its development –which is left out in Kant's theory of *a priori* logic – by focusing on the growth of logic and the development of symbolic structures. Since the goal of his theory is to understand the development of such structures, it is theoretically plausible (and ideal) that abstraction takes over experience as the individual develops. But the question of how we think about spaces cannot to be approached separately from questions of where, why, and when we think of spaces. It is mostly in the everyday world that we think of spaces, as we move through them, and Piaget's theory seems to be escaping the embodiment and activity of cognition. In short, in Piaget's conception, the mind is seen as disengaging cognition from encounters with the

world. As the subject develops, he/she subordinates everyday experience to formal, symbolic or abstract representations.

While Piaget's environment is a physical one, Vygotsky's (1962; 1978) is a socio-historical one. Essentially, Vygotsky considers the environment as the source of development, not as its setting. Along with Piaget, Vygotsky posits that the relationship between the child and the environment (physical and social) is dynamic and changing. This environment influences the child differently according to his or her degree of environmental awareness, constitutional characteristics, and given emotional experiences. Both suggest a connection between the environment and psychological processes, but contrary to Piaget, Vygotsky suggests that higher mental functions appear first in an inter-psychological level (between people) where the actions of the child become internalized. From shared action emerges a construction of meanings that the child will further internalize. This principle underlines the role of the other in the child's development, attributing meaning to her actions (socialized). The basic idea is that higher mental processes develop from a process of symbolic mediation. In other words, the child acquires "sign systems" that are socially constructed and historically determined. Once acquired, sign systems promote a transformation of the mental functions rendering from symbolic functions.

Like Piaget, Vygotsky stresses the function of actions in the development of human intellect but also makes a clear distinction between the so-called "lower" processes – those involved directly with the external world: sensory-motor thought

– and the "higher" mental processes developed later: deliberate memory and symbolic thought.

This line of theorizing served as a conceptual base to further study spatial cognition. Considering the spatial context in which cognition occurs and actions as a cause and product of cognition, interest developed to study the way large-scale environments are symbolically represented.

B. The representation of large-scale environments

When studying cognition of space in large-scale environments (cities for example), representational theorists focus more on the value of specific physical elements in people's cognitive representation of the city than on the elements *per-se* or the way they structure the city. The relevance of the attributes is directly linked to the value they acquire in a cognitive representation (for example, a building is only relevant as a landmark or aid for navigation). A review of representational theories is relevant to the study of wayfinding because purposeful behavior in space requires at least some degree of manipulation of internal representations.

In a publication that encourages investigators to examine spatial cognition in large-scale environments, Siegel and White (1975) suggest that the ability to operate within complex spaces implies the existence of spatial representations. Individuals must have a mental code of the physical world in order to understand, move around, and interact within it. They further propose that the development of

spatial representations follow a particular course in which landmarks are first remembered and route knowledge is later developed. This sequence is followed ontogenetically by children mastering spatial relations and microgenetically by adults learning a new environment.

This model proposes that the development of spatial representations of large-scale environments is composed of three components and is cumulative and hierarchical. Landmarks are first recognized and remembered. Acting in the context of these landmarks, people construct sensimotor routes along which landmarks are first ordered and later organized according to their interrelationships. With additional experience and/or development of higher-order cognitive skills (such as perspective taking), multiple routes are organized into configurations, that is, coordinated representations that can be used flexibly for environmental navigation and for other forms of spatial and non-spatial problem solving. As the route knowledge of the person becomes more detailed and enriched, eventually a survey (spatial) representation of part or all the space is believed to exist. This knowledge is organized as a spatial representation that offers comprehensive knowledge of the relationship of landmarks and routes (Siegel and White, 1975). As will be further discussed, I suggest that this comprehensive knowledge –acquired through experience in one or more urban environments, develops into a generic city template that people use to understand and make sense of new environments.

According to Kaplan (1976), spatial knowledge can be seen as a continuum ranging from the specific on one end to the completely generic on the other. Generic knowledge provides the basis for comprehending new environments based on prior experience with similar environments. I equate the concept of generic knowledge to my concept of template, since both are generic in nature and develop from previous experience in cities.

C. Route knowledge and spatial knowledge

An important factor to consider when addressing people's representation of the city and its development into a template is the way (or format) this information is stored in meaningful ways that will later be retrieved to aid wayfinding and purposeful spatial activity.

Environmental cognitive theory makes a distinction between two types of environmental knowledge: route (or sequential) knowledge and spatial (or configurational) knowledge (e.g., Evans, 1980; Golledge, 1987). Route knowledge includes important landmarks in the environment and the routes connecting them, and refers to information represented in a longitudinal manner, usually gained through direct experience (e.g., navigation). Spatial knowledge refers to a more global representation of the environment according to an Euclidean reference system. Cardinal directions and metric distances serve as coordinates to map spatial relationships among distinctive locations within a

network of routes (Garling, Lindberg, Carreiras, and Book, 1986). Spatial knowledge is the generic and global information of the city.

In my study, both types of knowledge are addressed by asking participants to sketch maps of Manhattan (spatial knowledge) and of the route traveled (sequential). I suggest that both are interconnected in people's representation of the city and provide a tool for wayfinding. At the same time, both are enriched or developed through activity in space (e.g., walking), which enhances people's knowledge of the city first at a route level (the frequently traveled routes get to be represented) and eventually at a survey level (when this route knowledge is incorporated into the spatial map of the city).

In a study by Moeser (1988), participants who had acquired route knowledge through navigation showed no evidence of acquiring knowledge of the entire environment. These results support the notion that people use different environmental devices, but fail to explain the source of such differences.

Appleyard (1970) carried out a study in Ciudad Guyana, Venezuela, designed to identify group differences regarding how people draw cognitive maps and structure cities. Similar to the participants of my study, Appleyard's subjects developed two types of maps: route and spatial. His results showed group differences in structuring maps according to education, temporal familiarity (with increasing familiarity the use of spatial elements became more common), and spatial familiarity (spatial elements were more predominant in maps of inhabitants' local areas than those of other parts of the city). He observed many

participants striving to fit their knowledge of urban areas into a coherent schema even when simplification was needed. He suggested that people appear to structure the city in varying schematic ways, such as oversimplified routes and salient indicators exclusively.

Wood (1973) suggests that there is a generic sequence in the creation of a sketch map that is probably at the root of spatial cognition. This sequence is presented as follows: Point phenomena are perceived and cognized more readily; linear phenomena are next perceived and cognized; and finally, areas are perceived and cognized.

D. Cognitive maps

Research in the 1970's focused on people's internal maps and their representations (e.g., cognitive maps as a product). Since representations of the city were equated with spatial cognition – that is, it was believed that people carry "mini maps" in their head – cognitive maps were used as the main method for understanding the way people acquire, develop and organize spatial information. In my research, I use people's sketches of their cognitive map only as one tool of a battery of methods to study processes involved in wayfinding, not as a research product itself.

Downs and Stea (1973) define cognitive mapping as "a process composed of a series of psychological transformations by which an individual acquires, stores, recalls, and decodes information about the relative locations and attributes

of the phenomena in the everyday spatial environment" (p. 17). This notion is similar to Hart and Moore's (1973) concept of spatial cognition that refers to the knowledge and internal representation of the structure, entities, and relations of space.

Kitchin's (1994) general belief is that a cognitive map not only explains the understanding of spatial behavior, but is also a mental construct that actually influences behavior. I agree with this position, but disagree with his methodological approach, which suggests "by examining a whole range of spatial products we can understand spatial decision making and subsequent behavior" (p. 68). I believe this method alone does not provide deep and complete information about spatial cognition because the cognitive repertoire used for spatial activity and cognition consists of many other elements besides cognitive maps. Furthermore, the capacity to act and move intelligently through space may occur before, and possible in the absence of, the capacity to represent space (Spencer et al., 1989).

Magliano et al. (1991) suggest that the study of space leads to a simultaneous investigation of thinking, feeling, and acting in the environment. With this conceptualization, internal cognitive processes such as thinking are put together with the environment and action as a focus of research. Earlier, Cohen (1985) assumed space cognition to be the union of spatial knowledge and the understanding of the physical and social nature of environments all in relation to

cognitive functioning. This conceptualization does not necessarily include activity in space as part of the phenomena of study, but it suggests its relevance.

Kitchin's (1994) piece on cognitive maps suggests that place is the focus of human interactions, thus bringing the focus of study in cognitive mapping closer to both meaning and action. Along the same line, Spencer et al. (1989) support the notion that cognitive maps are not isolated and context-free. Instead they are formed during purposive activity. These approaches show a trend that starts to put cognitive maps and their study in a situated context.

In his critique of the methodological trend of using cognitive maps to study cognition of space, Wood (1973) suggests that cognition of a city is configured by attributes of the environment (complexity, legibility, etc.) and of the subjects. He claims that this complexity of factors has not been taken into account in previous spatial cognitive research.

In the current study, I use cognitive maps as a tool for understanding the interactions of people's representations of the environment as well as their use of that environment. A distinction has to be made between cognitive maps – the mental representation of space – and my use of the word template, which is also a spatial representation, but it is generic in nature. The template of "City" comes from the integration of different experiences and representations of cities. It is a generic outline used to interpret new urban environmental information.

E. The relevance of plans and memory for acting in a large-scale environment

When studying large-scale environments, many researchers are interested in the mental manipulation of spatial information, and the representation and integration of information derived from the successive activity demanded by large-scale environments.

From a representational approach, Vera and Simon (1993) claim that plans (as internalized thinking processes) play an important role before and after action, but only minimally during action. There is no causal relationship between the plans and the actions performed by an intelligent system. From their perspective, the subject receives information (perception) and the response is an outcome (motor process) mediated by symbolic structures. All sequences of action can be executed with interchange among perception, internal processing (thinking) and a motor response. In this way, they strongly oppose the Situated Activity approach, which does not emphasize the internalized processes as much.

Thoughts about both temporary spatially distant events and potential actions of imagined actions (i.e., plans) are examples of a type of processing that involves the creation of some kind of prior and identifiable stand-ins for the absent phenomena –inner surrogates that make possible behavioral coordination without the guidance of external input. In the case of planning a route to get to a destination, success partly depends on the internal representation underlying behavior.

In representational approaches to the study of cognition of space, the general principle of a permanent knowledge structure assumes an observer who is being stimulated by what happens "out there," as opposed to an active agent who interacts with real everyday settings as a developing process. The general trend suggests that a series of central processes occurs internally (e.g., memory, pictorial representations) and as a result of these, the individual acts in space. From this perspective, activity is conceived as the result of these processes, not as an integral part of a developing process of spatial knowledge and use, as conceived in the current study.

Another line of research in cognitive psychology seeks to understand how the spatial structure of the environment is represented in memory, and how remembered spatial relations are used to guide action in space. McNamara and his colleagues (1997, 1998, 2001, 2002) are particularly interested in determining the spatial frames of reference used by human memory systems to represent the locations of objects in the environment. Their research has led to investigations of the relationship between object and scene recognition and the acquisition of spatial representations from non-visual information, such as verbal descriptions (e.g., directions). From this perspective, memory and information retrieval is fundamental for navigational tasks and spatial behavior. In the context of spatial cognition, I suggest that many cognitive processes involved in wayfinding are based on memory. For example, a cognitive map is stored by/in a memory

structure and is retrieved when needed, either to form a plan or to make a decision while navigating a route.

Additionally, findings of these studies (e.g., Shelton, A.L., & McNamara, T.P., 2001) underline the importance of understanding differences in spatial experiences as well as in the tasks used to probe spatial memory. In the context of my study, it is important to note that wayfinding tasks have an effect not only on participants' performance but also on their learning processes and mental mapping of the routes and areas. Several of my research study participants reported they would not have paid attention to specific environmental information or mental processing had it not been for the interview. As will be further discussed, we need to bear in mind that the research methods (walk-along interviews and map-sketching) had an impact on the data (i.e., peoples' wayfinding behavior and performance) and on people's spatial awareness. The task impacted participants' learning of the city by inducing them to structure new spatial information.

II. Situated Activity

Another theoretical approach to the study of spatial cognition focuses on the link between what happens internally (i.e. symbolic representations) and the environment (physical structures). When studying the cognitive phenomena related to representations of large-scale environments, at least two elements need to be considered: the organism that cognizes and the environment that is being

known and represented. A third element in the spatial cognitive system is then the activity that links or places the embodied mind (the individual) in the environment.

In this Section, the environmental theories of spatial cognition are reviewed as one of the theoretical bases of the Situated Activity approach. These theories emphasize the value of environmental structures in people's understanding of space, specifically in the case of cities.

A. Environmental approaches to spatial cognition

While representational theories focus on the internal cognitive aspects of spatial cognition, environmental approaches, such as Lynch's pioneering work *The Image of the City* (1960), prioritize the environment over cognitive structures. Lynch identifies the physical elements that are most meaningful in structuring a representation of the city, thus allowing an understanding of space and making possible the effective use of large-scale environments.

Perhaps the most significant aspect of Lynch's work is his contention that a different type of process besides internal processing needs to occur in order to successfully move through large scale environments. Lynch describes two aspects of urban environments, their "imageability" (the impact of a given urban component upon a person), and their legibility (the degree of order in the relationships between entities of variable imageability).

His methodology deals with visual form in an urban scale and identifies the city's elements: paths, edges, districts, nodes, and landmarks. Lynch subjected his data (sketch maps and questionnaires) to content analysis and displayed the results in two images, one from the verbal information and the other from the sketch maps. Using these maps as data, he discussed problems of orientation, navigation and symbolization in the organization of three American cities. His method of collecting and analyzing data is not fully explained in *The Image of the City*, maybe because of two main methodological problems that were present in my research as well: First, the way in which maps are collected (i.e., sketched) and, second, the way they are analyzed.

There is considerable research has studied the city elements described by Lynch in relation to people's representation of the city. These studies, however, do not take into account the processes involved in the acquisition and development of this knowledge (e.g., moving through the city). Although the relevance of actions in most research is neglected, the results of such studies still contribute to the understanding of the value of the physical environment and its elements in relation to the way people get to know and use a new city. Variables such as familiarity and/or experience are accounted for and should be discussed when referring to the changes in people's cognition of the city through time. For example, Devlin (1976) found that paths were the predominant city elements, although their importance varied according to the degree of familiarity with the city. People who knew the city and had mastered part of its structure thought

more in terms of specific paths and their interrelationships. People who knew less about the city relied more upon small landmarks and less upon regions or paths. This study underlined the importance of generic knowledge about cities in the reaction to any particular locality. The rapidity of cognitive map formation suggested that participants with any type of knowledge of cities were able to use it in their development of a map.

Other landmark studies investigate the influence of landmark information on the acquisition of spatial information (Ferguson and Hegarty, 1994). Results of these works suggest that salient landmark locations have a greater impact on wayfinding and navigation than do ordinary locations.

Besides landmarks, people use other resources, such as maps or directions to acquire spatial information. Research indicates that the use of maps increases the performance of direction pointing tasks, distance estimation tasks, and estimation of global relations and distances (Giraudo & Pailhous, 1994; Moeser, 1988; and Thorndyke, 1982).

B. Situated activity as the focus of spatial cognition

The situated activity approach focuses on two major phenomena: (1) the structures of the world and how they constrain and guide human behavior, and (2) upon relationships among events, people, and the external environment. From this perspective, internal representations are not the main factor for activity (behavior) in space, but a limited approximation of spatial knowledge.

Suchman (1987) questions the nature and relevance of the concept of cognition supported by Vera and Simon. She focuses on action rather than cognition, and points out that activity is always situated and embodied. Even actions that require planning or analysis result in situated activities, not in mere cognitive, internal processes as suggested by mainstream theories. The embodied and situated nature of action is partly due to the changing conditions of the environment to which the person responds in a more immediate manner. In this way, even plans are situated actions, not cognitive processes.

Suchman places her emphasis on "constructing accounts of relations among people, and between people and the historically and culturally constituted worlds that they inhabit together" (p. 98). From this perspective, no action can be understood outside of its social, historical, and cultural context.

The condition of the production of action is related to Gibson's (1979) concept of "affordances" as existing only in the interaction of the invariant elements of the environment and their use or potential use by a member of a species (Gibson, 1979). Representational authors like Vera and Simon (1993) explain these affordances through central processing -- it is the complexity of the mediation that allows the simplicity of the affordance. But with this explanation they contradict the essence of the Gibson's concept in which organism and environment are linked by each affordance. The term implies the complementarity of the environment and the organism. The environmental features are not just abstract physical properties, they have to be relevant for an organism or group of

organisms. An important value of the concept of affordances is that they are objective, real and physical. They differ from representations, values and meanings, which are often subjective, phenomenal and purely mental. By this, Gibson suggests that an affordance is neither subjective nor objective. Rather it contains elements of both.

Gibson's ecological perspective unites the organism with its surroundings. The organism is a complex object of the world and part of the environment. Humans are perceivers and behavers of and in the environment, and all behavior and action take place with respect to events we can perceive. Gibson's focus, therefore, is on how these perceptions occur in a world consisting of meaningful things and events.

C. Main critique to Situated Activity

Representational theorists try to integrate the notion of situated activity to their conceptualization of cognition of space. For example, for Vera and Simon (1993) affordances are mental constructs found in the head not in the environment, and are the result of complex perceptual transformation processes. In a Gibsonian way, it is the complexity of the affordance that creates the need to theorize in terms of cognitive structures. In other words, the representational cognition occurs when the environment demands it –either when the environmental information is too complex (i.e., problematic), or insufficient.

With a critical review of Situated Activity, Vera and Simon conclude that all of the Situated Activity findings can be incorporated into a traditional symbolic paradigm. According to these authors, Situated Activity studies bring our attention to an important phenomenon – situated behavior, but offers no new theoretical constructs that are not already present in previous work.

III. Middle-ground: The situated function of cognitive representations

Wood (1971) provides an overview of the history of studies of the perception of the city. This history has two tendencies, according to Wood. First, the city is presented as the home of people and the breeding ground of their institutions. Second, the city is purely a physical entity. Wood credits the union of these two theretofore-parallel tendencies to Lynch, and presents a framework that underlies the historical perceptions of the city. He suggests that the nature of representations is intrinsically related to movement, which is goal oriented. With this notion, he is introduces the value of actions in the formation of cognitive maps. "It is goal oriented movement that demands environmental knowing, and it is the nature of human goals that has been overlooked in the analysis of data" (p. 76).

Similarly, Appleyard (1970) focuses on the integrative nature of cognition of space, studying the operational role of city elements. As a person uses the city,

performing various tasks, he/she selects particular aspects of the environment for the purpose of carrying out these tasks. Appleyard (1970, 1973) suggests an active perceptual individual who is in search of meaning and builder of meaning. As individuals grow up they develop a generalized system of environmental categories, concepts and relationships that form their coding system for the city – our personal urban model. As a person moves around the city, he/she actively searches for meaning: perception is inferential. When we encounter a new city, we match each new experience against our general expectations. In this way, events are "placed" and social patterns are inferred.

Greeno and Moore (1996) present a critique of information processing approaches, claiming that this theory and related methods cannot account for behavior, especially in tasks that involve direct and changing interactions with the environment. They deny that symbolic processing lies at the heart of intelligence and posit that cognitive activity should be understood primarily as interactions between agents, physical systems, and other people. Symbolic operations are only part of the phenomena: "individual and social phenomena will include hypotheses that use symbols, but others will not." Their approach tries to bridge the gap between Situated Activity and symbolic processing perspectives. Differently from Vera and Simon (1993), they present symbolic cognition as a specific case of cognitive activity, giving more relevance to the role of activity in cognition, whereas Vera and Simon favor symbolic processes.

Clancey (1993) presents a more conciliatory point of view with which I identify. He suggests that the structures and processes that coordinate perception and action are created during activity, therefore perception and action arise together automatically. Agre (1993) suggests that neither approach is right or wrong, but they are simply different positions that focus on different sets of observations and phenomena. While the symbolic worldview focuses upon the distinction between events in the world and internal processing, the Situated Activity worldview focuses upon relationships among events, people, and the external world. Similarly, Spencer, Blades and Morsley (1989) suggest an active organism and focus on how individuals encode environmental information as well as how they carry out actions and plans on the basis of this stored information. Actions, for them, are an outcome of spatial cognition, not an intrinsic part of it, as I suggest.

Varela et al. (1993) oppose the idea that "cognition is fundamentally representation," (p. 9) and develop the idea of cognition as "enaction." They concern themselves with the active nature of perception and the way our cognitive organization reflects our physical involvement in the world. Their discussion of the "embodied mind" presents two relevant issues. First, they discuss the active nature of perception and the way cognition and its related structures reflect the involvement of the individual in the world. Second, they suggest the notion of reciprocal causation between cognition and action. In the current work, I support this reciprocal causation by introducing the concept of a recursive map-

making/wayfinding system (See figure 13. Map making-wayfinding model). By understanding cognition as *enaction*, they do not depict cognition as the internal mirroring of an objective external world. Instead, their focus is on the sensorimotor interactions between agent and world as the basic object of study.

Similarly, on their approach to cognition of space Golledge and his colleagues (1985) suggest that specific cognitive processes common to all individuals include internal processes (e.g., feature extraction, concatenation, pattern matching and generalization) that depend upon the innate salience of different features (of the environment) for different individuals. The assumptions of acquisition of knowledge needed for representation are embodied in four major components of Golledge's conceptual model. These components include the actions taken during navigation, the knowledge structures that encode environmental knowledge, the cognitive processes of perception and memory, and the control processes that determine the interaction of the decision-maker with the environment. This model is based on internal cognitive structures but certainly takes activity into account. The basic episodes stored in long-term memory are processed and transformed during all wayfinding activities.

The essence of the conceptualizations presented above is that action or potential action is a critical component in deciding what environmental knowledge is accumulated and how it is used. From my standpoint, this still omits considering the recursive relationship between what is being represented from the environment and the actions taking place in the environment. While these theories

point out that action affects cognition, they do not identify how cognition affects action. Therefore I take an even more integrated approach in my study. I suggest that an effective way of assessing the symbolic cognitive aspects of getting to know and use a new city is through descriptions of the environment as people move through it. These descriptions are integrated with the use of the environment and framed by the individual specific contextual aspects.

I argue that some situations require information processing and some others are performed in a less symbolic, more situated manner. For example, wayfinding in an unfamiliar environment may require the use of old environmental prototypes such as how a familiar city is organized (e.g., grid pattern streets). On the other hand, moving through a more familiar environment may result in a less attentive, conscious activity in which the person is simply doing a task, such as getting to a familiar place.

In this line of thought, Wood (1973) suggested that discussions of spatial cognition are futile without consideration of the complex nature of the cognized environment. Moreover, the discussions of the nature of cognized environments are futile without consideration of the complex nature of the cognition of space. Wood points out that "neither are meaningful without concomitant consideration of beliefs, values, attitudes, preferences, and other subjective assessments." (p. 665)

A 1996 publication, "*Being there: Putting Brain, Body, and World Together Again*", Andy Clark helped to shape my understanding of the continuity

between the internal processes and the external world, passing through the body (as enactor) and manifesting in actions or activity. Clark's work is partly based in notions developed in the field of artificial intelligence, based on a connectionist approach that relies on computational models.

The connectionist perspective suggests that there is no central cognitive process, or process of symbolic form, but that the units of the system respond directly to the environment. Clark does not accept this notion as a full explanation of knowledge. Instead, he takes an intermediate posture between connectionism and symbolic approaches by suggesting that mental manipulations are manipulations of the world.

Brains evolve as controllers of bodies, moving and acting in the world, so computational resources are complementary to the actions they control. In this way, the external environment becomes a key extension to our embodied mind and the idea of dividing lines between perception, cognition, and action is abandoned. Similarly, research methods that artificially divorce thought from embodied action-taking are not adequate when placed in the context of cognitive science of the embodied mind.

Clark views the brain as a kind of associative engine and environmental interactions as an iterated series of simple pattern completing computations. The cognitive system is self-organizing, where "some kind of higher-level pattern emerges from the interactions of multiple simple components without the benefit of a leader, controller, or orchestrator." In this conception, "intelligence and

understanding are rooted not in the presence and manipulation of explicit, language-like data structures, but in something more earthy: the tuning of basic responses to a real world that enables the embodied organism to sense, act, and survive" (p. 4).

While defending the "decentralized" approach to spatial cognition, Clark assigns new value to the different components of spatial cognition. Without reservation, he argues that the human brain sometimes integrates multiple sources of information and that central processing sometimes intervenes between input and output, since it is not always a time-costly process. For example, we can mentally simulate an external arena and, at times, internalize cognitive competencies that are nonetheless rooted in manipulations of the external world. After all, he says, "Individual brains remain the seats of consciousness and experience" (p. 68). But although he locates thought in the brain, the flow of thoughts and the adaptive success of reason are seen to depend on repeated and crucial interactions with the environment. Humans are truly distributive cognitive engines; we call on external resources to perform specific tasks. Brain and world collaborate in ways that are richer and clearly driven by computational and informational needs.

Coinciding with Suchman, Clark suggests that in many cases, a plan turns out to be something partial and immediately dependent on properties of the local environment. Contrary to Agre and Chapman (1990), he claims that plans are not a specific, complete sequence of actions separate from the context that need to be successfully performed to achieve some goal. To the extent that the brain does

hold internal representations, a large body of those representations will be local and action-oriented rather than objective and action-independent.

IV. Wayfinding as purposeful spatial activity

Wayfinding, understood as the ability to relocate from one place to another in a large-scale environment (Blades, 1991), is not only the object of study of this dissertation, but its description helps us to understand the more general nature of spatial cognition. As with other cognitive phenomena, wayfinding involves internal information processing as well as the use of physical environmental elements at hand. It is also an intrinsically embodied activity, since the person is actively getting from one point to another.

Following the trend of spatial cognition studies, wayfinding research has focused either on the physical elements or on the cognitive structures and their respective roles in getting to know places. By studying a cognitive activity that occurs in space, wayfinding research implicitly (and sometimes explicitly) connects representational and environmental structures. For example, focusing on the internal structures of cognition, studies (Hogan, 1975; Naveh-Benjamin, 1987; Passini, 1980; O'Neill, 1991) have shown that individuals receiving complex spatial information may experience difficulties forming an accurate representation. They suggest that wayfinding behavior and spatial orientation are affected by the

complexity of the environment. But such studies have failed to address the relevance of immediate experience in the environment and the value of specific features at any given moment of wayfinding. It is precisely when studying complex environments, given the difficulties of processing and representing them that embodied, immediate experience may be most valuable for navigating, especially in new cities.

Because of my interest in the relationship between internal processes and environmental structures while wayfinding, it was important to select routes and areas with different characteristics and problematics for people to perform wayfinding tasks. Changes in the complexity of the environment allowed the observation of changes in the strategies used for wayfinding.

Another trend in spatial cognition has been the rise of research designed to assess how individuals obtain information about their environment, investigating the relevance of landmarks in navigation and wayfinding. For example, Passini's (1984) studies in wayfinding use spatial problems as tasks (for example, the execution of a route), and suggest that landmarks are useful when navigating through an environment. Moreover, spatial decision plans require environmental information. His conclusions about decision making in wayfinding consider cognitive as well as environmental factors, but fail to integrate the personal and contextual aspects of spatial cognition that this dissertation addresses.

Passini argues that the execution of decisions and plans can be seen as a matching-feedback process, where matching relates the expected object image to

the perceived object. Where there is a match, feedback sets the action part of the decision in motion; where there is a mismatch, it leads to further problem solving.

Garling, Book, and Lindberg (1985) develop the concept of a travel plan, where "travel" is equivalent to "wayfinding." Their concept of a travel plan is important because it links movement and travel in everyday environments to internal information processes (acquisition, storage, maintenance of orientation, planning). The limitation is that their studies have only been performed in the laboratory and fail to consider real contextual variables. They analyze the cognitive map as a cognitive structure serving adaptive behavior and are not interested in demonstrating the relevance of the environment to the task. They present some interesting conceptualizations of the relations between cognitive processes and the environment. For example, by stating that "travel plans are likely to be neither complete nor detailed enough to execute without observing the environment," Garland et. al. place relevance both in the cognitive and the environmental aspects of the process.

In previous wayfinding research (Bronzaft, Dobrow, & O'Hanlon, 1976; Lawton, 1996), participants received a wayfinding task in which they had to navigate routes of different complexity. Their cognitive representations and actual physical structures such as landmarks as indicators were measured in a quantitative form. Results of these studies only show the relevance of certain physical elements in wayfinding and spatial cognition in general without

explaining the interactions between them and the person. From my perspective, this is an overly simplified way of understanding a complex phenomenon.

Integrating environmental and internal structures, a study by Schneider (1995) describes three different ways of acquiring spatial information: map reading, navigation and reading spatial descriptions. Results indicate that maps and navigation most often provide the reader with explicit locations of landmarks but do not address the way these interact to afford purposeful activity.

I suggest that people's wayfinding depends both on environmental cues and cognitive representations (symbolic processing) of the city. In other words, wayfinding is framed by the context in which the person is navigating. Wayfinding must be studied through people's actions, which engage both the symbolic representation of space and use of the environment.

Another interesting aspect of the current study is the examination of the transformation of wayfinding into waydoing. Wayfinding is a process that uses internal cognitive structures as well as environmental elements. Through repeated exposure to a route or an area, cognitive structures give way to a more embodied behavior that I call "waydoing." Cruising is an intermediate stage between wayfinding and waydoing and generally occurs when a person has decided a plan (e.g., a route) to follow, but still is to some degree attentive to environmental cues or internal information that reinforce the decision and may affect the plan. The journey has to be remembered.

Spatial cognition and behavior studies that consider familiarity in an environment as a variable affecting navigation need to be revised. For example, Garling et al. (1985) address familiarity issues, suggesting that if an environment is familiar then a travel plan fulfilling the goals defined by the action plan will be directly retrieved from long-term memory. If no travel plan is available, one is formed and information is accessed from the cognitive map and/or from available media (e.g., maps, people). The accessed information and the travel plan are acquired and stored in a cognitive map. As the number of retrievable travel plans increases, the need to form travel plans decreases. When the travel plan is incomplete, it needs to be developed in response to the information received from the environment.

Whereas the cognitive map literature is concerned with cognitive mapping by observation and measurement of environmental representations (e.g. Evans, 1980), Garling and his collaborators' framework incorporates an active subject, as exemplified by the assumption that the environment is learned from media (maps, other people) as well as through direct experience.

These authors see the environment as both posing problems and offering means for their resolution. In this model, travel plans entail several hierarchically organized stages of information processing – accessing information from a cognitive source, media such as maps, and from direct observation. They conclude that the information-processing approach appears to be a viable framework for understanding many of the problems in the field of spatial

cognition. They analyze wayfinding as decision trees focusing on what important information went into decisions at different levels. At least in unfamiliar environments, planning and execution of travel plans are interwoven. Although these authors suggest that conclusions about decision-making in wayfinding consider cognitive as well as environmental factors, they fail to address the time and space influences on spatial cognition and action that I address in this dissertation.

Cohen and Cohen (1985) suggest that people construct their knowledge of environments from their experiences in these environments, and offer tentative conclusions about the role of activity in spatial cognition. They propose activity-in-space as a mediator for many cognitive changes. As a general index of activity-in-space, (defined as length of residency in the setting and amount of exposure to novel spaces) the research tends to confirm the expectation that the greater one's experiences in a space, the greater one's spatial knowledge of the space. As they note, however, this is at best a very crude measure of activity-in-space. Although a certain amount of exposure to an environment is of course necessary to glean spatial information, it seems to be far more critical to determine the nature of the individual's activity when assessing the development of spatial knowledge in large-scale environments. Studying the changes in active individuals' wayfinding makes it possible to understand transformations of the cognitive structure and its interactions when dealing with large-scale environments by considering the multiple aspects involved in spatial cognition, including internal (e.g., symbolic

processing), mediational (e.g., activity and behavior) and environmental (e.g., a street sign) factors.

In my approach to spatial cognition, I study the relevance of the aspects related to the phenomena of wayfinding. I suggest that the repertoire of strategies used while navigating a route includes internal/symbolic, mediational/behavioral, and external/environmental elements. Spatial cognition research presented in this chapter has focused on one, or at best, two of these elements. In general, I do not strongly disagree with any of these theories but feel that combining elements of these theories as guided by data leads to the greatest understanding of spatial cognition. That is why I identify more strongly with integrated approaches that focus on the interactions of the internal processing with the environment, such as the ones presented by Wood, Clark, Appleyard, Green and Moore, Clancey, Arge, Golledge et al., and Spencer et al.

I believe that at some but not all stages of wayfinding, symbolic processing is extremely relevant. So studies that focus on these elements, such as Vera and Simon's, contribute the most to my understanding of the phenomena. My critique to this approach is a matter of degree rather than of substance. Such theorists favor internal processing over situated actions at all times, whereas I suggest that depending on the specific instance of navigation (e.g., first time navigating a route, having a map, knowing the city), an individual will use internal resources to a more or less degree, compensating with more situated, environmental resources (e.g., using a street sign or following people). Similarly, I do not completely agree

with the Situated Activity approach, which favors activity over internal processing, since I believe that in some instances, the person needs to use symbolic resources (imagining a map of the city and deciding on/planning a route ahead of time).

With my work, I intend to inform about the complexity of spatial cognition by describing the repertoire of strategies used while wayfinding. I claim (1) that these strategies include internal cognitive processing, the use of environmental structures, and the activities and behaviors that bind them together, and (2) that the use of the processes and structures of this repertoire changes with time and spatial channeling.

CHAPTER III

METHODOLOGY

I. Research goals and specific research questions

The general objectives of this study are:

(1) To describe the process by which adults get to know and use a large-scale environment. This is accomplished through primary research (qualitative) that studies the procedures and structures that play roles in the wayfinding of newcomers in Midtown and Downtown Manhattan; and

(2) To test my hypotheses that wayfinding consists of a repertoire of processes and strategies, including internalized representations of space, situated actions, and use of the environment.

The following specific research questions stem from these general objectives:

1) How do newcomers to New York City (i.e., people who moved in up to six weeks prior to the first interview) get to know/understand the city in terms of its spatial organization in order to get from one point of the city to another by foot (i.e., wayfind) in Midtown and Downtown Manhattan?

2) What representational processes (such as memory, decision making and cognitive mapping), environmental structures (such as landmarks, street configuration, and street signs), and mediational tools (such as maps) play a

role in people's ability to get from one point of the city to another by foot (wayfinding)?

3) Does wayfinding consist of a repertoire of strategies including inference of spatial organization and functioning, use of a city archetype, use of mental representations, use of the environment, and map-making? If yes,
    1) What is the nature of these strategies? Are they internal (i.e., representational), external (i.e., physical/environmental), or mediational (i.e., maps)?
    2) How do these strategies function together to facilitate wayfinding?
    3) How does the use of the cognitive processes, environmental structures, and the way they interact to afford wayfinding change as a result of time and environmental channeling (understood as the way the city's physical elements combine "framing" spatial behavior)?

To answer these questions, I developed a research design that considers relevant aspects of various approaches to human spatial cognition (discussed in Chapter II). Basically, I integrated elements of research methods used in traditional cognitive psychology, environmental studies, and situated activity studies and drew on them. For example, I took cognitive mapping –mainly a cognitive method- to the next level by conducting a longitudinal comparison of

people's maps. I accounted for people's actions by recording my own field notes of their behaviors.

As will be further described in this chapter, I used open-ended, walk-along interviews, parallel commentary notes on participants' behaviors and the environmental context, and cognitive maps or sketches by participants as data to support my thesis.

The reader should be aware of a potential conceptual misunderstanding when referring to the term "cognition" in this study. From the cognitive psychology perspective, the term "cognition" often refers to an internalized symbolic structure (e.g., a cognitive map). It would thus be paradoxical to talk about cognition from a situated activity perspective. The latter perspective gives little relevance to internalized processes and information in getting to know and use space. Therefore, for the purpose of this study, "cognition" will not refer to a stable internalized structure, but to internal processes by which people get to know and use space.

II. Research Design

A. The setting

This research focuses on the participants' development of spatial knowledge and use of the Midtown area of Manhattan. I used the Graduate Center of City University of New York on Fifth Avenue between 34th and 35th Streets as the starting point for all interviews. Data were gathered by interviewing participants first in a conference room in the Graduate Center, then as they walked around the Graduate Center area, and finally as they found their way walking to different destinations in Midtown and Downtown Manhattan.

The wayfinding task changed in each time period. For each interview and observation period, a segment was added to the route traveled in the previous stage. Through an expansion of the wayfinding route in each stage, I was able to gather data on processes involved and strategies used in new environments (because participants' familiarized themselves with the first and second segments after traveling and learning the routes). Variations in the setting (e.g., weather, areas under construction) were accounted for as the data were gathered and analyzed. This enabled the comparison of spatial strategies and actions as they developed in particular contexts.

During the wayfinding task of the first interview, participants were asked to find their way from the Graduate Center to the Barnes & Noble bookstore in Union Square. In the second interview, the participant walked from the Graduate

Center to Barnes & Noble, and from there to Washington Square. The final destination for the third interview was the Angelika Film Center, located on the corner of Mercer and West Houston Streets in the downtown area.

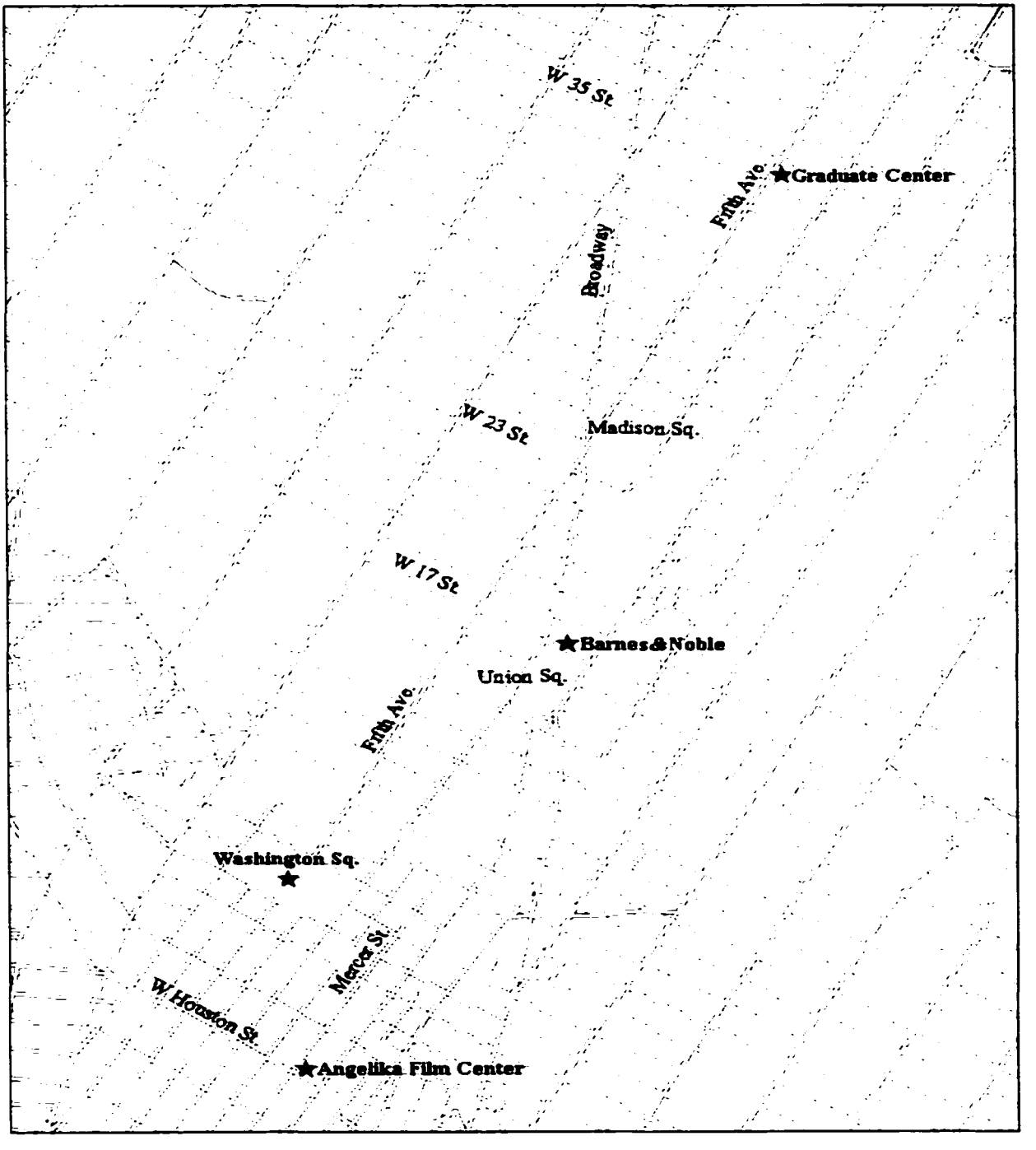
The destinations in Midtown area were carefully selected and did not include an address. Although no address was given of the destinations, each were easy to locate on map or by other means (e.g., asking for directions).

The Midtown area is not strictly defined as such in maps, so participants sketched and referred to an area that was defined *a-posteriori* from 42nd Street to Houston Street. It should be noted that the perception/experience and representation of what elements and distance constitute Midtown varied from participant to participant.

The area and routes were selected as the focus for this study in an effort to obtain consistent data in terms of what participants' experience, learn, and use of their environment as they negotiate a common area. Participants' strategies and experience varied, but the general environmental elements remained largely constant. Weather conditions were similar for all interviews, since all interviews were performed between 12:00 and 4:00 p.m. and between September and December 2000. Since the academic year starts in the fall, incoming students approached to participate had moved a few weeks before the semester started in September. Time 1 interviews took place in September, Time 2 interviews happened at the end of October/beginning of November, and Time 3 interviews were done in mid-December. A common characteristic on Time 3 interviews was

the cold weather. Although I was bale to observe changes in actions due to the climate (e.g., people walking faster or entering buildings or shops to warm up), I did not use these differences as part of my conceptualization. The study of such environmental conditions and the way they affect spatial behavior and perhaps environmental representation is an interest that I may further explore.

Figure 1. Midtown and downtown area as the setting for this study



* All maps from MapInfo software

Characteristics and problematics of the setting

For analysis purposes, the three routes chosen in the Midtown and Downtown areas were arranged in three segments, based on their characteristics and problematics. The characteristics of the physical environment and the problematics encountered in each one are central factors when studying wayfinding, since these elements afford or hinder behaviors, actions, and cognitive processes such as decision-making. Studying people's actions and their speech in problematic points of a route renders access to important information regarding their wayfinding strategies. These problematics of space precipitate the linkage between symbolic processes and situated actions.

Problematic points can be defined as points in a route or area in which the common pattern is disrupted. A problematic can be very specific, as in the Graduate Center-Union Square segment (where the problematic was the specific intersection of Fifth Avenue and Broadway on 23rd Street) or more generalized, as in the Washington Square-Angelika segment (where the city pattern from above Washington Square changes). Segments were selected as the ground to study the actions and processes which emerge in problematic and non-problematic points, and the way these actions and processes differ and why.

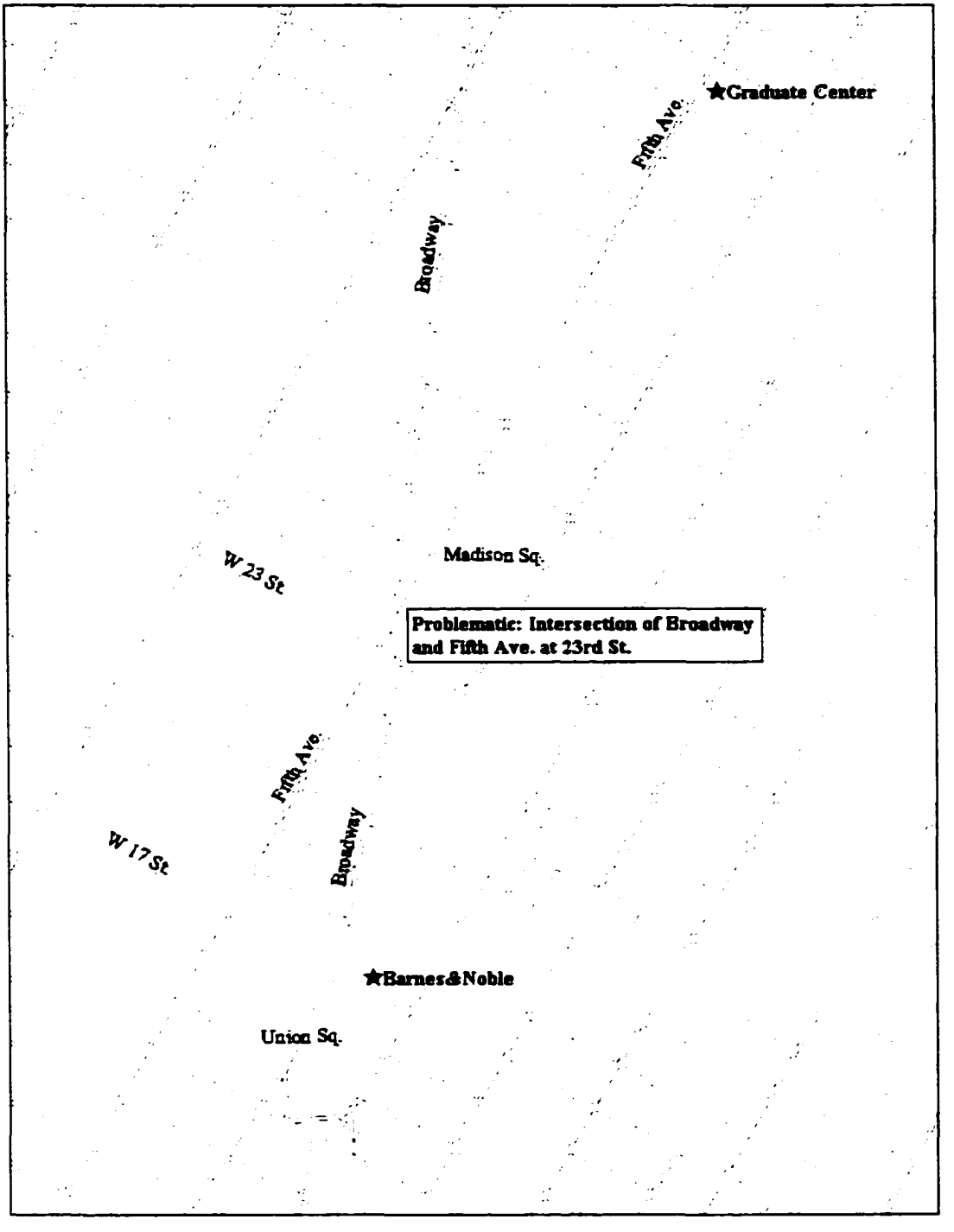
The unit of analysis at these points was the correlation between the participant and the environment. That is, a unit of action of the embodied mind in an environment.

Segments presented the following characteristics and problematics:

Segment 1. Graduate Center- Barnes & Noble, Union Square

This segment follows the general street system of Manhattan. The streets basically constitute a grid structure follow a numbered sequence that decreases towards Downtown. The exception to this system is Broadway, an avenue that runs diagonally, conflicting with the regular grid pattern of the segment. The problematic manifested itself at the intersection of Broadway and Fifth Avenue on 23rd Street, where participants had to make the decision to continue walking on the same street (channeled by the angle of the street, now Broadway), or cross the street in order to continue walking on Fifth Avenue.

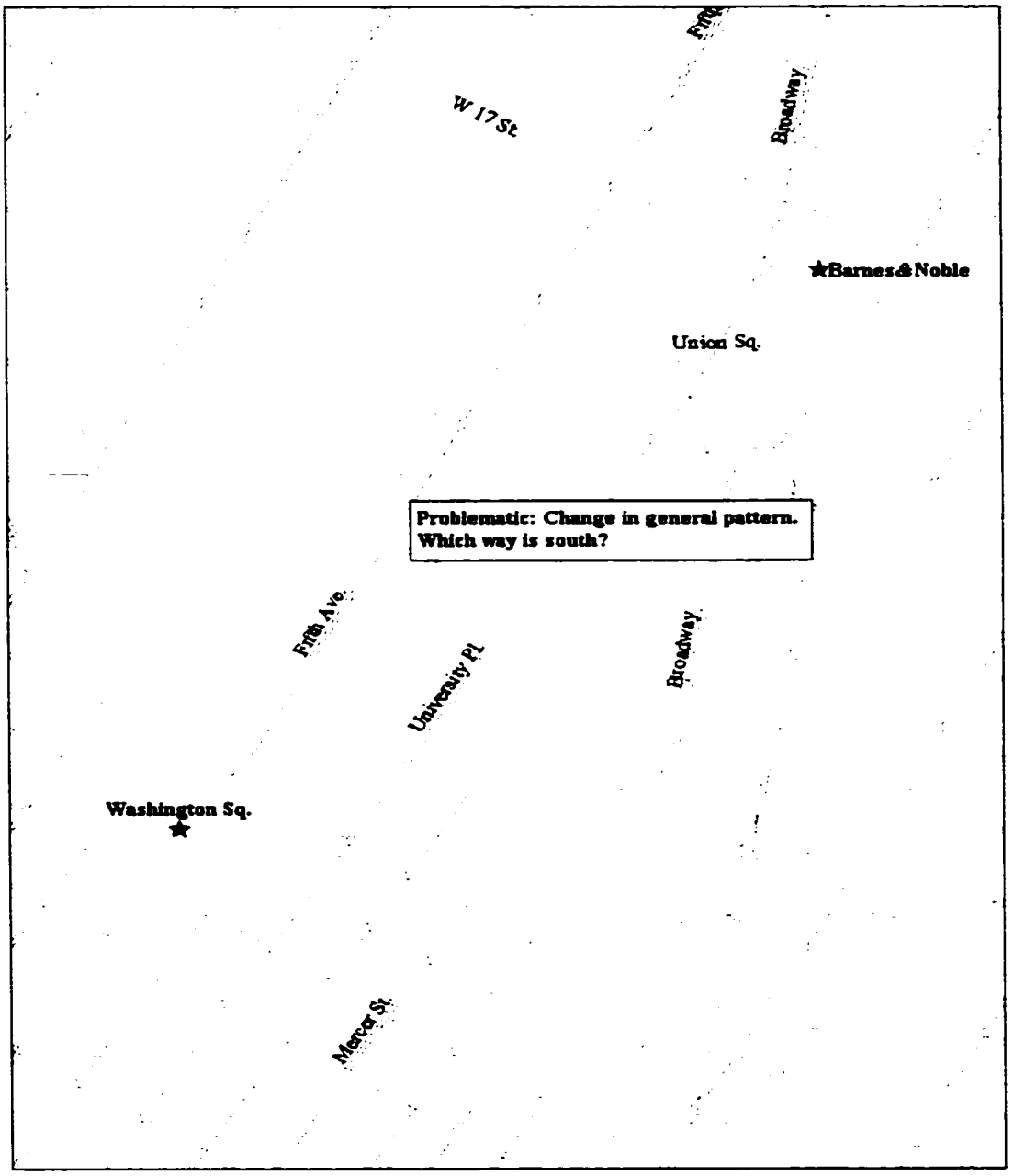
Figure 2. Segment 1: Graduate Center (Fifth Ave. between 34th and 35th Streets) and Union Square



Segment 2: Union Square to Washington Square

This segment encompasses routes between Manhattan's general grid street system and an area that does not completely follow this general pattern (the area below 14th Street). Although most streets continue in a grid pattern, some of them are not numbered but have names instead. The extension of Broadway south of Union Square presents a continuation of the previous pattern, but is not the most direct route to Washington Square. The problematic was to identify a street that would lead the participant south. The most direct route was University Place (which most participants thought was the continuation of Broadway). Fifth Avenue was a less direct alternative.

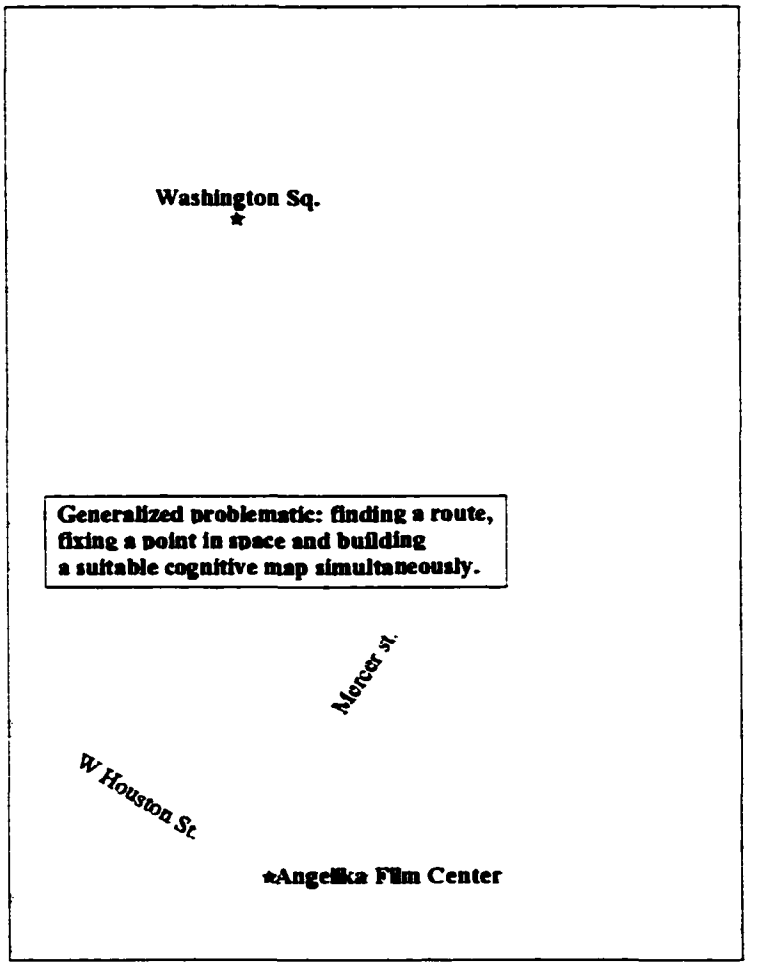
Figure 3. Segment 2: Union Square to Washington Square



Segment 3: Washington Square to Angelika Film Center

This segment is an example of one of the "less legible, more complex" areas of Manhattan that does not follow previous grid and numbered street systems. It presents a totally different logic of the city and the route. The problematic in this segment is generalized to finding a route, fixing a point in space, and building a suitable cognitive map simultaneously.

Figure 4. Segment 3: Washington Square to Angelika Film Center (West Houston and Mercer Streets)



B. The participants

I started with an initial sample of 10 participants, and after a first stage of analysis reduced the sample to 6 people who were interviewed in 2 additional periods of time. All participants of this study were: over 21 years old; first year students in a doctoral program at The Graduate Center of the City University of New York during the Fall 2000 semester; fluent in English, and; had moved to New York City 6 weeks or less before the first interview.

Because the nature of this study is qualitative, it was difficult to determine the ideal number of participants *a-priori*. I based the original number on my previous research and on David Seamon's work on everyday experience of the environment. In determining the number of participants, it is important to establish a balance between what will bring insight and what will allow depth in the analysis.

In my prior studies of wayfinding, I interviewed 10 people during one time period. Results were informative enough and deep enough to draw conclusions significant to my study. The current study built on concepts developed from those results, and a similar methodology was employed: in-depth interviews with people as they move through space.

I worked with ten participants at first to account for potential "experimental death" (i.e., participants leaving the study) and because I needed to interview all participants during their first six weeks in the city and before they became too

familiar with the environment. Based on results of a first approximation of the data where the categories for analysis where defined, I proceeded to select six participants to interview two subsequent times.

Because of the qualitative nature of the study, I did not employ statistical criteria in the selection of the group. I did not determine *a-priori* any segmentation variables, since I am interested in studying experiences of different people as they move through the city, and identifying general patterns of action. It was not my objective to describe what possible variables intervene for each personal pattern. The focus of this study is to document, describe and study the diversity of types of engagement with the environment, not to define the factors that explain this diversity.

In summary, a total of five men and five women were interviewed during the first time period. Three of these men and three of these women were interviewed two subsequent times, for a total of 22 total interviews.

	Time 1	Time 2	Time 3	Total
Men	5	3	3	11
Women	5	3	3	11
Total	10	6	6	**22**

The following demographic variables were noted for analysis: country of origin; geographic background (i.e., city/town/suburb); first language (participants' whose first language was Spanish were interviewed in Spanish, if they wished); age; gender; and previous visits to New York City –which turned to be an important element in some of the participants' representation of the city on the first interview.

The group of participants in this study was homogeneous in many ways. Of the group of six people who completed all three interviews, five lived on the Graduate Center dormitories on 18th Street and First Avenue and the other participant lived on Williamsburg, Brooklyn. The group was also uniform in age, since the ages ranged from twenty-two to thirty-one years old. Participants' navigated from their residency to the Graduate Center on a regular basis. A few had classes in other campuses (e.g., City College), and most of them had walked and explored, at least to some degree, the area between the Graduate Center and the dormitory.

I did not plan to have such a homogeneous group in terms of their place of residency in New York, age, and familiarity with the Midtown and Downtown areas of Manhattan. But this homogeneity served as a type of qualitative baseline on which other relevant information became more noticeable in the data.

Based on my own and other prior research (e.g., Appleyard, 1970; Devlin, 1976; Garling et. al., 1985; Lawton, 1996), variables such as literacy level and gender play a role on the way people represent space and move through it. For example, in my study of English-proficiency and signage use in the subway

system (unpublished), I found that people with different literacy levels use radically different strategies (e.g., people who cannot read signs need to use other strategies, such as asking). A study with a more heterogeneous and larger population would render access to the study of such characteristics and their impact on wayfinding within the theoretical context of action system suggested here.

C. Recruitment

The consent form approved by the Institutional Review Board was e-mailed to all incoming students by the Graduate Center's Residence Life Office as well as the Executive Office of all doctoral programs at CUNY during the last week of August and the first two weeks of September 2000. Students who responded to this e-mail were contacted by telephone to determine their eligibility. If eligible to participate, an appointment for an interview was scheduled. The consent form was signed during the first meeting with each participant.

III. Research Procedures

To provide maximum insights and deep information on the development of participants' spatial knowledge and use of the city, interviews were conducted at different phases within a 5-month period immediately after people had moved to New York City. In-depth interview on these questions were completed with all ten participants, who were also asked to produce a sketch/map in each of three sessions, with 4 to 6 weeks between sessions.

The interview guideline changed from Time 1 to Time 2 to Time 3. Questions were added and other removed based on my experience on previous interviews and preliminary data analysis. In this way, the study is not strictly repeated measures, since the interview guideline changed for each time period. In qualitative methods this development is expected.

Several studies of spatial ability among newcomers and of familiarity with an environment have been performed over three and six month periods (Bronzaft et. al., 1976; Devlin, 1976; Evans et. al., 1981; Passini, 1984). Results suggest that the major changes in people's representations of the city occur within the first 6 months. I chose to perform three interviews with each participant over a 5-month period and approximately 6 weeks apart.

There is no *a-priori* way to determine the ideal number of interview sessions to be performed with each individual in the 5-month period of data collection. I chose to perform three interviews considering a 6 to 8-week period

between interviews. In this period between interviews, participants' knowledge and use of the city developed, and I was able to identify and describe changes in participants' wayfinding while comparing their behavior through time.

The stages of each interview and sketch/map drawing were:

Phase 1: In-situ interview and sketch drawing

The objective of this stage was to gather data on the most symbolic, prototypic aspects of the participants' spatial habits and knowledge. The discussion centered on participants' spatial behavior in their hometown, before moving to New York City. This phase included two areas of discussion:

1. *Environmental experience in a familiar city or town.* This part included two sections:

(I) The city: A general description of their city or hometown and a specific description of a familiar area (i.e., home or school/work neighborhood). The objective was to bring awareness to the topic and to identify what elements are important in people's representation of a city.

(II) A route/wayfinding: A description of a frequently traveled route helped identify the function of environmental elements and significant interactions with these elements to facilitate or enable purposeful behavior and patterns of action such as wayfinding.

2. *Previous knowledge of New York City.*

This part of the interview focused on what the person already knew about New York City before moving to attend graduate school. We talked about what he/she knew before moving to the city and on what they had learned from the moment they arrived. The objective was to explore what people knew of New York City's spatial organization as well as how and where they learned this information. In addition, I explored what they had learned and experienced in the time that they had been in the city (between one and six weeks before the first interview). This information worked as a conceptual base to which additional experiences in the city were compared.

Interviews on times 2 and 3 only included the description and sketching of what participants knew and had learned of New York City. These data allowed me to conduct repeated trials for comparison and analysis. In all interviews the participant drew a sketch/map of what he/she knew of New York City and Midtown Manhattan. He/she was asked to draw the map with as much detail as possible. A total of three such maps were collected from each participant.

Procedure:

Phase 1 took place in a conference room at the CUNY Graduate Center, located on Fifth Avenue between 34th and 35th Streets. The discussion focused first on the person's spatial experience in a familiar city or town, and more

specifically in a neighborhood. Participants described a frequently traveled route in detail. When asked about their previous knowledge of New York City, participants were given several sheets of paper and a pencil to draw what they were describing. All interviews were tape-recorded.

Phase 2: Walk-along

Interviewing people as they performed a way-finding task in the city allowed the observation and recording of situated actions. I obtained data to test the general hypotheses that people develop theories of space (spatial organization) as they directly experience an environment for the first and subsequent times. This phase had 2 activities:

(I) Walking around: In each interview, the participant walked around the starting point area (Time 1 and Time 2: Graduate Center area; Time 3: Union Square). The objective was to identify those elements that were useful for developing a first-hand meaningful representation of the area. At the same time, by doing this in the actual environment, I recorded specific actions and interactions within the environment and its meaningful elements.

(II) Wayfinding: The participant received a wayfinding task (to get to Barnes & Noble at Union Square in Time 1; from there to Washington Square in Time 2, and from there to the Angelika Film Center in Time 3). The objective was to gather information about decision-making processes

in a situated context, that is, as people actually made decisions and integrated them into their actions. Regarding these wayfinding data, some important considerations must be noted:

- Because participants had been in New York City for a while, some of them already knew one or more routes to the destination.
- Participants became more aware of the route after the first time we traveled to the destination, than if we had not traveled this route at all. Their performance in subsequent times was affected by this knowledge since the wayfinding task increased their awareness.
- During the months of the study some participants may have visited the selected destinations more than others did, developing a more accurate knowledge of the area and possible routes.

The routes selected presented different environmental characteristics and problematics, and for analysis purposes were arranged into three segments: (1) Graduate Center to Union Square, (2) Union Square to Washington Square, and (3) Washington Square to Angelika Film Center.

Procedure:

After having described/sketched Manhattan during the *in-situ* stage of each interview, participants were asked to show me relevant places in the Midtown/Union Square area as they described to me what they were doing and

why they chose to do so. They were asked to address near-by places that they knew of or had been to even if we did not go there on foot.

Each interview was tape-recorded throughout the course of the walk. I used a second tape-recorder during this stage to register my field notes. Both tapes started recording at the same time and ran in tandem, thereby enabling me to record my observations simultaneously with participants speaking about their experiences. Specifically, I described in detail participants' actions as they were being performed and where. Through this parallel recording I recorded actions that complemented in-sync the re-representational data rendered by participants' speech. Through the parallel recording I also gathered data both as the participant was, and was not, talking. Participants were able to focus on the interview in the moments they chose to, focus on the environment and stop talking whenever s/he needed or chose to. In summary, decision-making and representational data came from participants' speech registered in the first tape recorder, and situated actions data came from my commentary notes registered in the second tape recorder.

After approximately 10 minutes of showing me around the starting point area (Graduate Center on Time 1 and Time 2 and Union Square on Time 3), the participant received the wayfinding task (to get to Barnes and Noble, Union Square). Participants were asked to "think out-loud" as they went to the requested destination, describing what they were thinking and when and what decisions s/he was making en-route.

The destinations were chosen considering the following criteria:

- Within comfortable walking distance of the starting point.
- An exact address was avoided by giving a more ambivalent but still clear direction: Union Square, Washington Square, Angelika Film Center.
- Areas had different characteristics within New York City's structure.
- Routes presented different problematics.

Phase 3: Map/sketch drawing and narration

The goal of this method was to identify the most significant elements in terms of what structures participants' image of the environment (including physical elements and actions, e.g., *"you walk straight here two blocks..."*), not to determine what they could recall or their drawing ability. Resulting data were analyzed qualitatively.

This method is similar but not the same as cognitive maps employed in prior studies. The current method is employed as part of a battery of complementary research techniques. The focus of analysis in the maps was the re-representation of physical elements (such as buildings and streets/avenues) of the Midtown area and the route traveled. This method consisted of:

(1) Map sketching – representation: the data were the elements portrayed, and the sequence in which they were portrayed.

(2) Narration: Data reflected not only these environmental elements but also a representation of the actions in space and interactions with the environment (e.g., *"here is where we had to cross the street..."*)

Procedure

Immediately after the walk-along interview, the participant and I sat at a comfortable place (Time 1 in a coffee shop on Broadway and 18th Street; Time 2 in Washington Square Park; and Time 3, inside the Angelika Film Center). The interview continued to be tape-recorded but the parallel recording stopped. Each participant was given several sheets of paper and a pencil, and was asked to draw a map of the Midtown area with as much content and detail as possible. They were also asked to draw the route they had just walked, also with as much detail as possible. Throughout this process participants were asked to describe what they were drawing and why they chose to do so.

IV. Summary of research methods

The in-depth interview and sketch/map performed in three time periods are summarized as follows:

Summary Table of participants

	Time 1	Time 2	Time 3
(N) Interviews	10	6	6
Phase 1: In-situ interview and sketch drawing SPEECH AND MAP/SKETCH	Get information on person's experience in a familiar city. Map/sketch of New York City/ Midtown	Information of what has been learned about New York City. Map/sketch of New York City/ Midtown	Information of what has been learned about New York City. Map/sketch of New York City/ Midtown
Phase 2: Walk-along SPEECH AND RECORDED FIELD NOTES	More time walking around the Graduate Center area, getting data on familiar, significant places, routes. Wayfinding from the Graduate Center to Barnes & Noble, Union Square.	Less time walking around the Graduate Center area, enough to gather data on changes from time 1. Wayfinding from the Graduate Center to Barnes & Noble, Union Square to Washington Square.	Less time walking around the Graduate Center area, enough to gather data on changes from time 1 and 2. Wayfinding from Union Square to Washington Square to Angelika Film Center.
Phase 3: Map/sketch drawing SPEECH AND MAP/SKETCH	Sketch of area and route traveled.	Sketch of area and route traveled.	Sketch of area and route traveled.

V. Data analysis and categorization

In the current study, I performed different data analyses that led to complementary results. Each analysis provided a new standpoint for an enriched approach to the data. One approximation recursively built on another, until I was able to draw conclusions and develop theoretical concepts.

1. Text analysis

As described, data consisted of the text of the transcriptions of the participants' speech while wayfinding different routes in Midtown and Downtown Manhattan. I also transcribed my commentary notes integrated to the text of their narratives using a different print. In the text analysis of data I identified three types of information:

A. Maps and routes

I started by identifying two general areas of information: data concerning spatial maps and data on sequential routes. By "spatial map" I mean the general representations that individuals have of the city at any time, which evolve and change. These representations develop mainly from generalizations regarding the organization of other cities, previous indirect exposure to New York (for example, through movies, books, stories), subway and other maps, and current experience of the city.

Sequential route information was generally presented by participants in a longitudinal format and was rooted in more direct experience.

B. Wayfinding strategies and spatial style

After these two types of environmental information were coded for, I proceeded to color-code the strategies employed regarding wayfinding and the participants' "wayfinding style." The categories coded were:

(a) Inference. Included all the internal cognitive mechanisms for organizing spatial information and decision-making as well as the use of existing templates. For example, inferring that going downtown means moving toward lower numbered streets.

(b) Experiential. Included information about the immediate interactions with the physical environmental and the use of physical elements to aid wayfinding and decision-making. For example: reading a street sign.

(c) Combined. Included the instances in which both rational and experiential strategies were being used simultaneously. For example using a map to locate where the person is at any point of the route.

(d) "Wayfinding style." Included subjective characterizations of the individual's personal way of moving through space and his/her preferences related to wayfinding and navigating. For example if he/she was more of an explorer than an "assertive wayfinder" (See Appendix 2).

C. Wayfinding and waydoing

Through these categorizations, I came up with another concept to be coded. It referred to the more situated quality of the wayfinding experience reflected by data that accounted for the development of wayfinding into waydoing. As will be further discussed, through time the more attentive behaviors involved in wayfinding gave way to a mode embodied, less attentive activity in space (waydoing).

2. Map coding

Each participant's data was transferred on to actual maps of the routes navigated in each phase of the project. Sequential connections involved in wayfinding were mapped for each participant. These sequential connections were represented by transcribing comments of participants and myself on colored Post-its. Each post-it note was pinned on an actual map, in the exact location that a relevant incident occurred. Color-coding on a map allowed me to identify patterns in wayfinding for each participant on different parts of a route and amongst participants.

Another map was used to draw a summary table of the route segments, their respective problematic areas, and participants' strategies at each point (See Appendix 3).

3. Cognitive map cross-sectional comparisons on different time periods.

Participants produced 2 maps in each interview. The first one was a map of New York City. The second was a map of the area and route we had just

navigated. By comparing these maps cross-sectionally and longitudinally, I was able to study patterns in the maps and identify which elements change through time or become more or less relevant. Generalizations of these results are discussed in Chapter IV.

CHAPTER IV

FINDINGS AND DISCUSSION

FINDINGS

Findings of this study are presented in the first section of this chapter and are grouped in three different areas: (1) spatial organization of Manhattan, (2) characterization of wayfinding strategies, and (3) development of wayfinding.

I portray Manhattan as configured by three levels or layers: the underground, the street level, and a "bird's-eye" level. Emphasis is drawn in the description of street elements and their physical organization, since it is claimed that spatial behavior in the city (specifically wayfinding) is channeled by environmental characteristics.

The strategies involved in wayfinding include inference, the use of templates (as mental maps of the city), use of the physical environment (e.g., a street sign), and map making (developing a mental map). These strategies configure and re-configure in different ways depending on the characteristics and problematics of a route, familiarity and knowledge of the area, and availability of maps.

The wayfinding strategies and their configuration change over time. The transformations of wayfinding into cruising and eventually waydoing –a more

embodied, less attentive behavior in space, are illustrated by comparing data of different time periods.

A glossary is included at the beginning of Chapter I in order to clarify the nature and source of the different concepts employed.

I. Spatial organization of Manhattan

In this work, the setting not only frames the phenomena of study (i.e., wayfinding) but it is also an intrinsic part of it. It deserves a detailed characterization both within the theoretical context and in the way it relates to the analysis.

While complex urban environments and their constitutive elements have been described previously (Lynch, 1961; Wood, 1973), the specific case and complex nature of New York City's multi-leveled configuration has yet to be studied. In New York, people develop an understanding of the city by integrating its environmental elements and layers. Results of this study suggest that people conceive the city as configured by three horizontal layers or levels that are (or get to be) integrated into a mental map of New York City. These layers are:

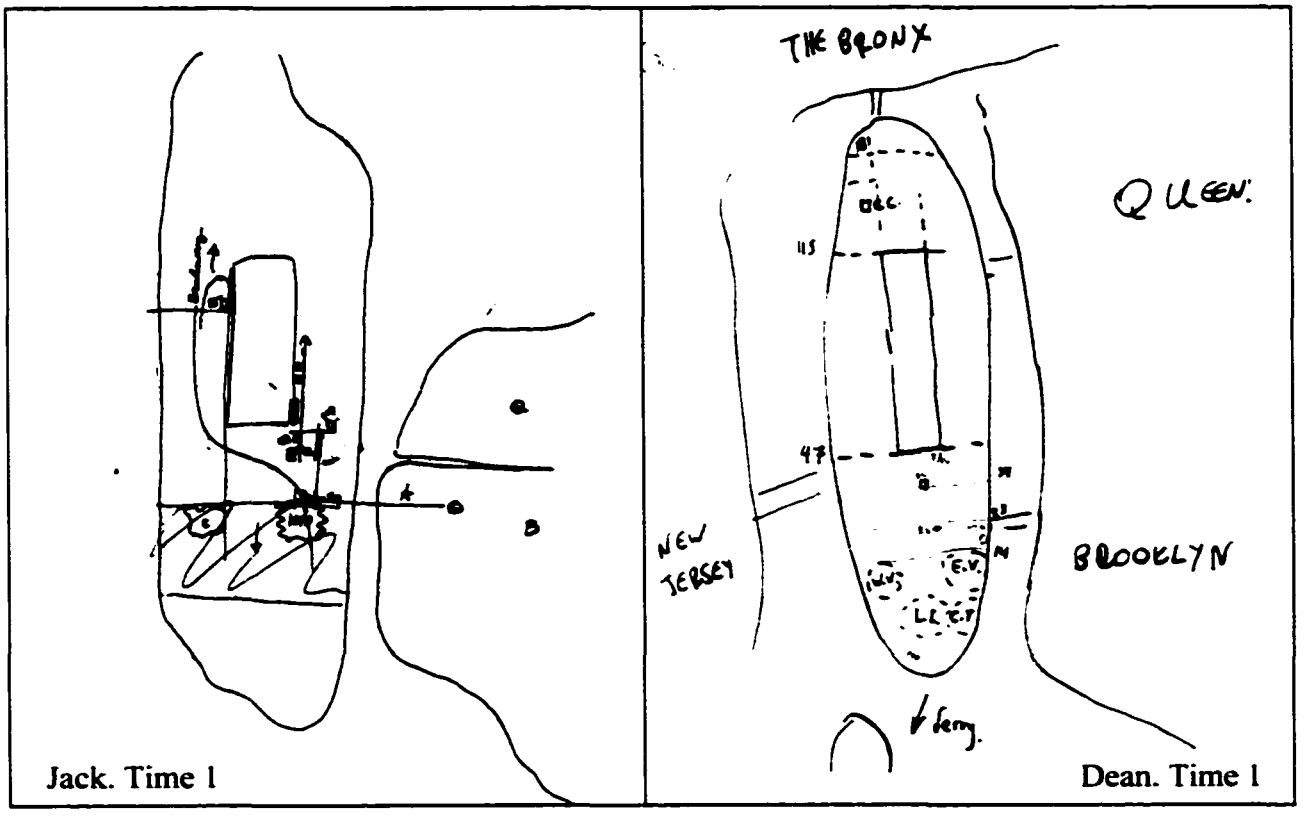
(1) Underground level. The complex subway network of New York City provides not only a means for transportation but also a frame of reference to understand and organize the structure of the street level. My results

indicate that people's templates of the city usually replicate the characteristics and distortions of a subway map.

All the spatial maps (i.e., non-route maps) of the city sketched by participants at different time periods mimic the subway map. *Some* participants included the subway lines in their maps of the city.

> " The map that I have of New York is the subway map, with all its distortions" (Rob, Time 1).
> " [My map] is going to look exactly like the subway map, not like a real map of the city, but it's ok because that's the way I learned it" (Dean, Time 1).

Figure 5. Sketches of Manhattan copy subway map



* Maps in the text are representative of the body of maps included in Appendix 3.

In these examples, Jack and Dean's maps of New York City (sketched on their first interview) look pretty much like a copy of the subway map. The common distortions in participants' sketches resemble the geographic distortions of the subway map. For example, Manhattan is the main element of the map; the island is enlarged as compared to the other boroughs, is represented vertically (north to south) instead of diagonally (north-east to south-west), and is shortened (i.e., proportionally much shorter and wider).

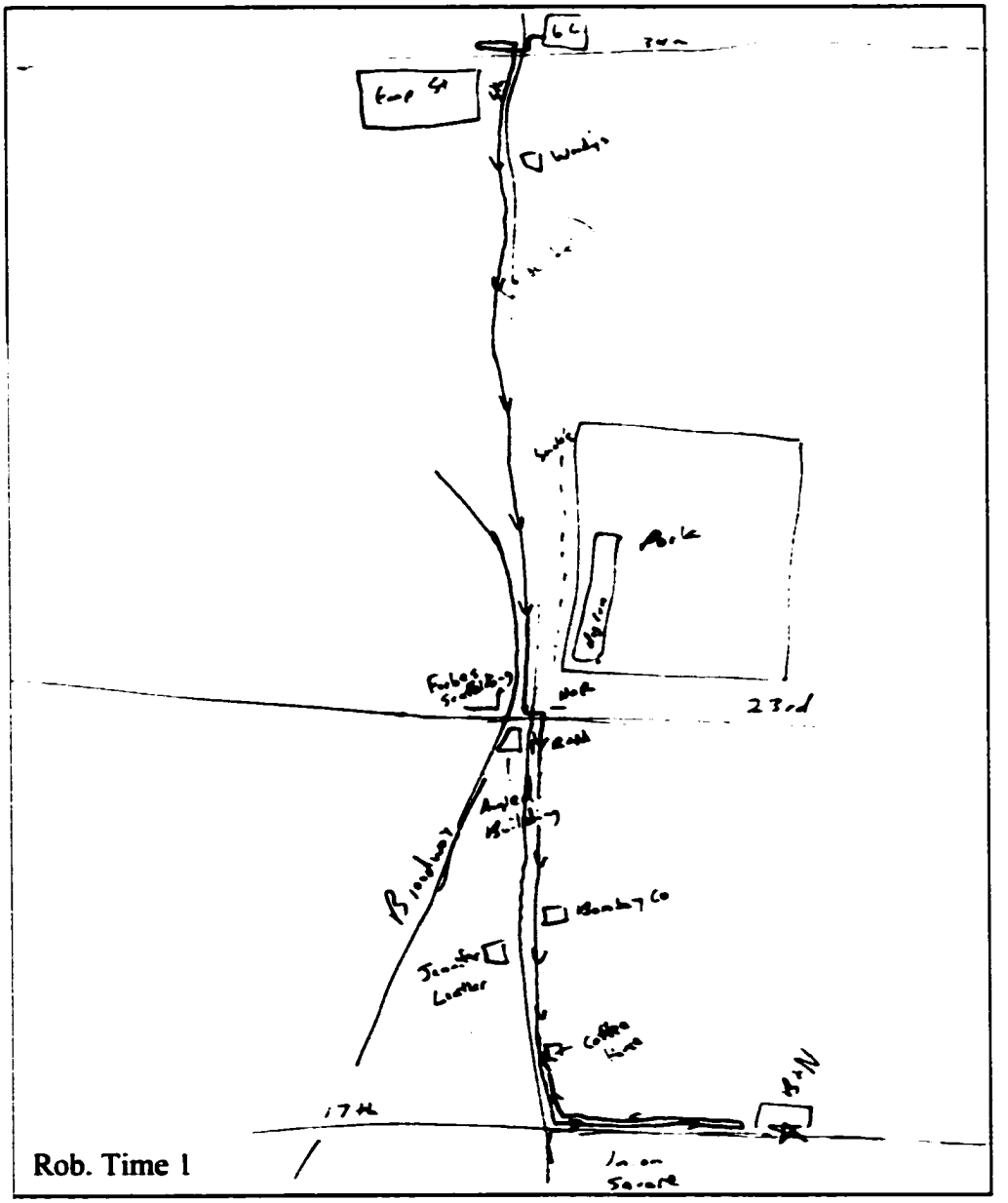
(2) Street level. My findings indicate that New York City's street elements and structure correspond to the elements of the city described by Lynch in *The Image of the City*. Based on participants' language, I have developed my own conceptualization of these elements as follows:

- Landmarks: Are salient points of reference with key physical characteristics. They can be prominent in two ways, either by being visible from many locations (e.g., the Empire State Building), or by setting up a contrast with local elements (e.g., a new building in an old neighborhood). Lynch characterizes landmarks as objective and "external to the observer" (p. 78), but I suggest that only the first type of landmarks (those visible from many locations) have this neutral characteristic. I propose that the contrasting nature of some landmarks has to do with personal reference points that have acquired their meaning or salience through personal experience. *All* participants in this study made use of these landmarks. In the following examples, the Flat Iron building and the Forbes advertising

sign were used as landmarks to identify a location. *All* participants made reference to one, the other, or both landmarks on 23rd Street.

> "I remember that Forbes ad, the red one. I know it's where Broadway crosses Fifth Avenue" (Rob, Time 1).
> "This is an important landmark. I don't know the name of the building but I remember where it is. It tells me that I'm getting closer to home" (Clarisa, Time 2)

Figure 6. Rob's map of route 1



Rob's sketch of the Madison Square area includes both salient city landmarks, such as the Flat Iron Building and Madison Square, and subjective personal landmarks, including the Forbes scaffolding and the subway stop for the N and R trains.

- Strategic points: Relevant points or junctions in the city like squares and important intersections (e.g., Madison Square and the avenues and streets around it). Lynch characterizes them as *Nodes*. *Many* participants referred to this type of points and said they were helpful in structuring their representation of the city.

> "The city is organized around squares and monuments. I can identify a few so far, but eventually will know most of them" (Mary, Time 2).
>
> "Squares are an important element of this city. It has many, and not necessarily a main one, like other cities" (Judy, Time 1).

- Connectors: In New York City, these are the streets and avenues themselves, and may be understood as Lynch's *Paths*, "the channels along which the observer... moves. They may be streets, walkways, transit lines, canals, railroads" (p. 47). The structure of the city provides the necessary and usable paths, which are the streets and avenues. *All* participants referred to streets and avenues as main elements of the city structure.

> "New York City has an easy grid structure. Streets run east to west and avenues run north to south" (Clarisa, Time 2).

> "I see the city as a group of significant places that are connected by streets and avenues. The places become significant to me, and then I learn ways to get there" (Jack, Time 1).

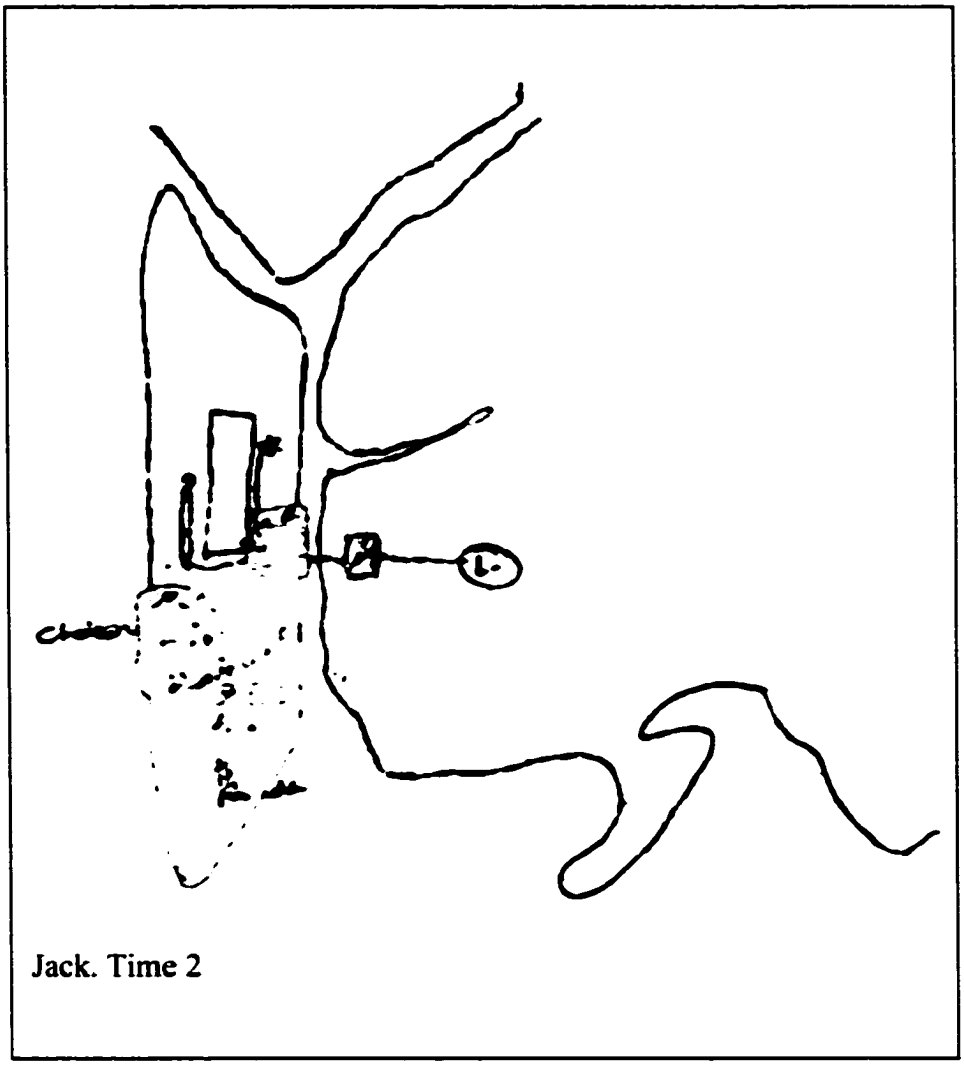
In Manhattan's case, these "channels along which the observer moves" often provide directionality and guide spatial behavior, thus facilitating a "cruising" mode of wayfinding. Because actions are framed by particular environments, people who cruise often choose not to pay attention to the task. The concept of cruising will be explained in more detail and exemplified in Section III, Development of Wayfinding.

- Pockets: Are areas that become more known and meaningful for a person. They are developmental in nature, since as time passes and a person repeatedly experiences an area, he/she gets to expand the extension and detail of a pocket. Eventually, pockets overlap and become larger and more detailed. Pockets correspond to Lynch's *Districts*, "the medium-to-large sections of the city... which the observer mentally enters 'inside of,' and which are recognizable as having some common, identifying character" (p. 47). *Most* participants referred to pockets, "clusters" or areas that get to be known in detail before others. They said the detail and extension of these pockets increased with time.

> "I know some areas more in detail... it's like a little pocket here and a little pocket there. I know how to move around there and then the rest of the city is like this huge gap. In time, the pockets will grow and overlap, and will become one huge pocket, I hope" (Jack, Time 1).

"So far I basically know the area between the dorms and the Graduate Center. It's like an island of what I know and then out there there's this whole world that I don't know but with time I'll start to learn... well, there're other isolated islands like where my friend lives around Columbia, I know a small piece of that area too" (Rob, Time 1).

Figure 7. Jack's map of Manhattan: Spatial pockets



Jack. Time 2

Jack's second sketch of the city represents, in his own words, "the pockets that I am more familiar with at this point," including the Graduate Center area, Chelsea, and the Union Square area. The concentric shades represent his expanding knowledge of these pockets.

- Barriers: Are obstacles in people's paths such as interruptions in the streets or avenues (e.g., Madison at 23rd) or construction detours. Lynch does not have a conceptualization for barriers. *Some* participants referred to obstacles they encounter in the city pattern such as being unclear about Broadway being east or west from their location since it runs diagonally.

> "I don't know exactly where, but Madison is interrupted at some point around 18th Street, I think, so I don't take it to go home" (Clarisa. Time 2).
>
> "It's weird when you're walking down on Broadway and you get to Columbus Circle. I never know what to do there because there's no logical way to cross south" (Rob, Time 2).

Instead, Lynch defines *edges* as "the boundaries between two kinds of areas" (p. 47). Although some edges may be identified in the city (for example, changes in street organization below Houston Street, where Houston is the edge), participants did not refer to this concept.

A singular characteristic of Manhattan is its street organization. *All* participants characterized the street level of the city as having a general system that is the same in most areas and a more complex organization in some specific areas. The general system described by participants presents the following characteristics:

- Grid street design. City blocks are rectangular. Streets intersect with avenues.
- Numbered streets and avenues. Streets are numbered starting at Houston Street and increase in number towards Uptown. Avenues are numbered east to west, with a few unnumbered avenues (York, Lexington, Park, Madison, and Columbus Avenues and Broadway).
- Because of the geographic nature of Manhattan, avenues are longer and wider than streets.
- Most street vehicular traffic runs only on one direction. Every few blocks, on some bigger streets, traffic runs in both directions (14th, 23rd, and 34th Streets, for example).
- Most avenues' vehicle traffic runs on one direction.
- Odd streets and avenues run west and south respectively, and even streets and avenues run east and north respectively.

I suggest that this city structure "channels" the possibilities of spatial behavior. The concept of channeling is similar to Gibson's affordances (an environment "affords" certain behaviors to members of a species), but it adds an element of actual directionality. I studied actions on the street level, where the nature of city blocks (a grid configured by streets and avenues, a relatively flat ground, and length of avenues, numbered streets, among other characteristics) channel walking behavior (and also motorized transportation) by providing additional structure to the environment. For example, when walking down a street, behavior is channeled by the direction of the street and the length of the block (there is no

other way to go but up or down the street). Data from my commentary notes and participants' speech demonstrate how the environment channels behavior since *most* participants referred to this environmental channeling. For example:

> *"We are still walking on the east side of Fifth Avenue. Jack walks without talking, at a comfortable pace, and every few seconds he comments something brief about the environment or the task. He is looking around, and does not seem to me particularly attentive or alert about the surroundings. It seems like he's just walking and thinking of things non-related to the task. A part of him seems to be on the wayfinding task since he talks about some features like street signs every once in a while."* (My commentary notes on Jack. Interview 2. Fist time on route).

> "I'm looking around... the buildings... always nice to get to identify new buildings or shops, or things that start to make sense...Here I read a sign 12th Street... basically, I just keep going down (*on Fifth Avenue and 12th Street*) because there's no other way to go. (*As he says this he moves his hands back and forth on each side of his head several times as to show to me that the street is the path, the only way to go.*) I'll see if I get there as soon as I get closer to 8th street" (Jack, time 2. First time on route).

Some specific, less recognizable and more complex areas do not follow the system described above. Streets in certain areas do not follow a grid system nor are they numbered (e.g., the downtown neighborhoods, such as Chinatown, SoHo, Tribeca, and Greenwich Village which were developed in the 1820's before the grid pattern for the rest of the city was implemented north of Houston). Although not all participants identified Houston as the division between the general pattern of Manhattan and the more complex areas, *all* of referred to the "areas downtown that are more complicated."

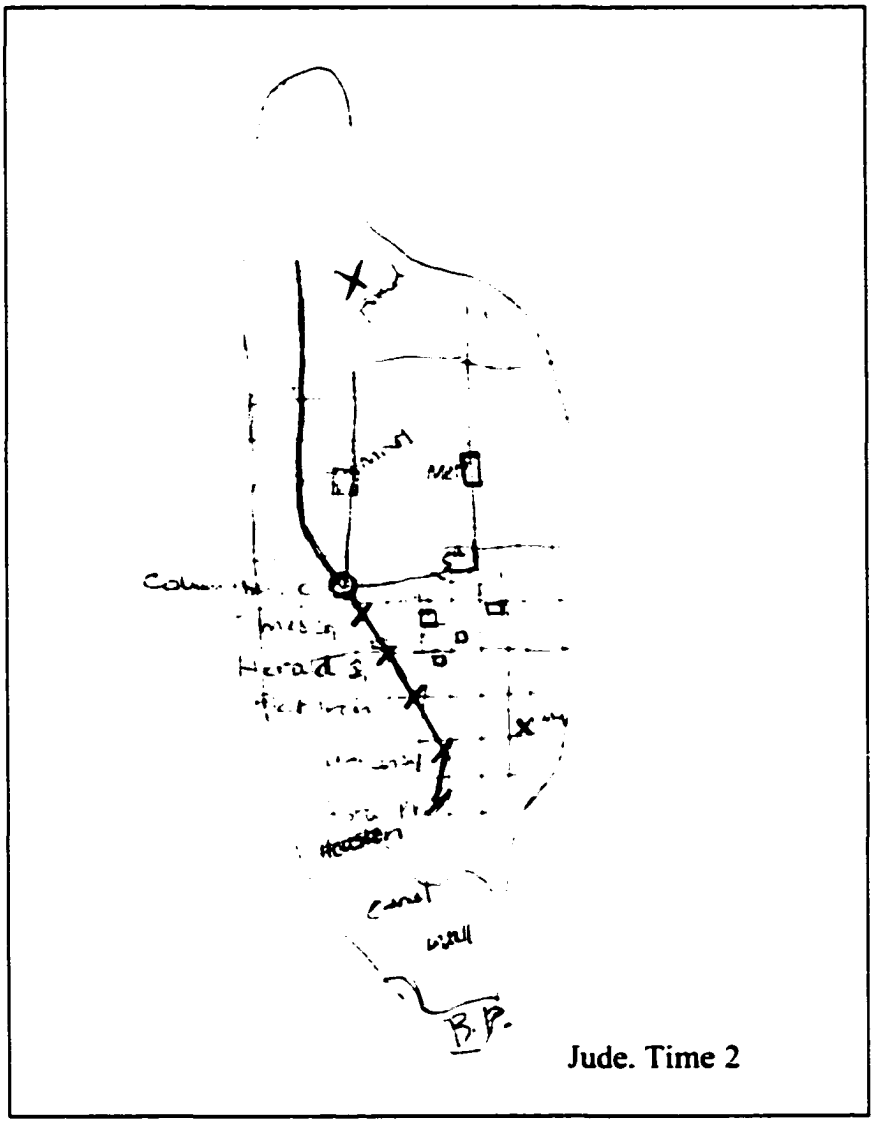
"I still get lost when I go to SoHo or around there. There's no way you can remember much or use any street as reference, besides Houston and Broadway (A*t this point Jack is not disoriented. He's talking about how complex downtown is as we walk down to the Angelika, but in this case he has already decided on a route and we're implementing it by walking down Mercer. We are on Mercer at West 4. Perhaps the fact that he had some more difficulty figuring out this route and that we're currently downtown and talking about wayfinding prompts him to talk about his experience below Houston*)" (Jack, Time 3).

(3) The third is the "bird's-eye" level, which refers to a subjective level, a developing cognitive map, usually sequential, configured by relevant indicators, including landmarks, paths, important connectors, and the elements of a familiar route. *Some* participants reported organizing the city around important avenues and intersections. They usually spoke about this type of information when describing their existing representation of the city and the way they organize new information by adding it to this aerial view.

> "As soon as I got here I started to identify another pattern that I hadn't thought of before. Besides the grid, the city connects points that are important city points like the squares or the park or monuments. The important avenues connect them [squares and monuments], like Broadway connects Lincoln Center, Columbus Circle, Times Square, Herald Square, and so on" (Judy, Time 2).

> "I don't know what's below here (Union Square) if you continue walking south on Broadway, but Broadway is a touristy path between must-sees. I'd tell a friend to walk down Broadway from Lincoln Center to Times Square, to Macy's, to here, and I guess it takes you to SoHo" (Rob, Time 2).

Figure 8. Judy's map of Manhattan. Bird's-eye view



Judy's map represents Broadway and the important crossing points at squares, monuments, or landmark buildings–Columbus Circle, Time Square, Herald Square, Flat Iron (Madison Square), Union Square, and Astor Place, as one of the structural elements of the city.

Unlike Judy and other participants who recognize monuments, *one* participant talked about organizing the city around shops.

> "I don't know why I have a map of many shops that I like. I locate things in reference to the closest Starbucks or a small cute boutique, like my friends' house up in Columbia" (Clarisa, Time 1).

The underground, street, and bird's-eye levels are not independent from one-another. Instead, existing and new information fluctuates from level to level. For example, the representation of the subway map many times serves as a template to which subjective "bird's-eye" information is added. Experiences of street level sites get to be integrated not only to the street level representation but also to the aerial one. Similarly, experiences and knowledge of the subway map and system serve to enhance the street representation and vice-versa. The way the information is organized and used depends greatly on the spatial task. For example, when deciding a route from the Graduate Center to Union Square, Dean used both the underground and bird's eye levels to decide on a route.

> "(*As we exit from the Graduate Center and he receives the destination [Barnes and Noble, Union Square], he stops and turns his body towards west and then south. We are on 34th Street and Fifth Avenue.*) I think... it has to be that way (*Pointing South-West*). I know that Union Square is a subway station and it's on 14th Street and I know the number 6 train runs under Park Avenue, and I know it stops in Union Square, so the safest way is to walk down Park Avenue to 14th Street and look there for the Barnes and Noble" (Dean, Time 1).

Later, while walking down Park Avenue, he made reference to many elements of the street that helped him organize incoming information, which was being integrated into his multi-layered representation of the city.

"I've paid attention to this building before because I like it. Do you know what building this is? (*He walks very slowly as he talks about the building as not to pass it before he finishes referring to it.*) I think it goes through all the way to the other side, to the next avenue... Madison? (*He is pointing east*). I think I will remember this building in the future, next time I walk by here. (*Once he's done talking about the building and resumes walking his speed increases*)... Now continue down to 14th Street. We're getting closer" (Dean, Time 1).

Summary of city structure

Underground	**Street level**		**Bird's-eye level**
	Elements	Organization CHANNELS BEHAVIOR	
Subway system Subway map	Landmarks Strategic points Connectors Pockets Barriers	Grid street system Numbered streets/avenues Avenues longer than streets Most streets and avenue run one direction Odd streets/avenues run west/south	Subjective Relevant indicators such as squares, monuments, or landmark buildings

II. Characterization of wayfinding strategies

My results indicate that people use different strategies when trying to get from one point of the city to another by foot. These strategies become relevant at different segments of a route, depending on personal (e.g., navigation style) and environmental characteristics (i.e., channeling).

In this study, I tried to identify patterns of behaviors and actions of wayfinding, rather than individual differences. Therefore, I focused on the general structures at cognitive (i.e., representations) and action (i.e., behavior) levels when analyzing the data. Familiarity with the environment and the characteristics of the setting were controlled variables. *All* participants had moved to New York City no more than six weeks prior to the first interview. *All* of them navigated to the same destinations. Furthermore, five out of six participants lived in the same place (Graduate Center dormitory on 18th Street and First Avenue) during the length of the study. The one variable left for future comparative analysis was the participant's personal navigational styles (See Appendix 2: Description of participants).

The verbalizations of participants and my commentary notes reflected their use of five different wayfinding strategies: (1) inference, (2) use of city archetype, (3) use of mental representations, (4) use of the immediate environment, and (5) map-making.

The use of these strategies and the way they combine to afford wayfinding changes through time. The development of wayfinding into the more embodied behavior of waydoing will be discussed in Section III of this chapter.

Inference

Inference refers to the use of logic for making decisions related to finding one's way to a destination. Considering the environmental characteristics of Manhattan, *all* participants in this study used inference as a strategy in route-segments and areas that follow the general street system –areas where streets follow a grid format and are numbered.

> "New York is very easy to learn. It's like a baklava, cut in rectangles... like a grid" (Dean, Time 1).
>
> "New York is a very logical city. There's not a lot of margin for error once you've learned the basics, although some areas are much more difficult and do not make a lot of sense, like Downtown" (Rob, Time 1).

An example of this strategy is following the street numbering system by inferring its relation to cardinal points. When wayfinding, if an upcoming street decreased in number *most* participants concluded that the sequence of street numbers would continue to decrease because of the nature of the numeric system.

> "After 20th Street you have 19th and so on... it's natural" (Judy, Time 1).
>
> "Since this is 32nd, I know the next is 31st and so on until we get to 14th Street" (Clarisa, Time 1).

From the Graduate Center to Union Square and from Union Square to Washington Square people inferred solutions to problematics based on this

pattern. Participants knew or eventually figured out that numbers decreased when going downtown or south.

> "I figured out quickly that street numbers decrease towards south and increase as you go up" (Judy, Time 1).
>
> "Now I know that the numbers decrease towards south... You have 181st Street all the way up at the end" (Dean, Time 3).

Most participants eventually figured out that avenues are numbered starting on the extreme east and increase towards the west.

> "I live between First and Second Avenues. That's all the way east" (Dean, Time 1).
>
> "First you have First Avenue, then Second, and so on until Eleventh, I think, although some avenues have names like Madison, Park, or Columbus. Columbus is only on the West Side" (Jack, Time 2).

Most participants apparently could not use inference to wayfind from Washington Square to Angelika Film Center because the streets are not arranged in a grid nor numbered. To find their way to the Angelika, these people made use of other strategies, such as asking people or using a map.

> "I don't think streets are numbered down there... not to the East of Houston, that I know, so I'll have to ask someone" (Jack, Time 3).
>
> "Please let me have your map. I really wouldn't know which way to go. If that doesn't work, I could ask... but let me see the map first" (Dean, Time 3).

Use of "city archetype"

A "city archetype" can be understood as a map that includes generic characteristics and elements of all previously experienced cities to which a

developing map of a new city is incorporated. For example, most (if not all) cities are constituted by streets, avenues, roads and highways/freeways, buildings, squares, plazas and monuments, signs and street lights, advertising boards, bus stops, and side-walks. The representation of the specifics of a city is build "over" this archetype.

Results suggest that the city archetype "branches" into a specific map in a newly experienced urban area.

> "Like in most cities, there's a logic to New York, but New York is easier. Here, the avenues are very long and run up and down. In Marietta the streets were more or less like in New York but in a smaller scale" (Judy, Time 1).

> "If you're from a city, from a big city, it's easier to move around. They are similar. Not like in a small European town where streets go all over the place. American cities are quite straight forward, although some have the freeways and you must certainly need a car to move around, but in all you have a logic to them and signs to help you out"(Rob, Time 1).

Participants talked about archetypical information of cities during our first in-situ interview, when we spoke about their experience in previous cities and in Manhattan so far. *All* participants had lived in cities and suburbs of cities for most of their lives. Although participants did not refer to specific information of previously experienced cities as an aid to wayfind Manhattan, the presence of these archetypical elements is intrinsic to the data. Taking for granted such archetypical elements (e.g., signs, street lights, streets, buildings) indicates their value in the way people organize and mentally represent spatial information. For example, when saying "I'll read the name of the next street in the sign," Mary was probably assuming that the street would continue uninterrupted, that the street

would meet a crossing point with another street or avenue, that she would find a street sign.

Mental representation

By the time they moved to Manhattan, *all* participants had a mental representation of the New York City developed from a city archetype and their knowledge of New York from previous visits, as well as from indirect information from media, books and maps. By the time we first talked, people had integrated new information acquired during their first weeks in the city to their representation. On the first interview, a*ll* participants referred to elements that they had mapped through previous direct and indirect experience.

> "I knew a bunch of things about Manhattan. What you see in movies and stuff... it's as if you had been here before and you recognize Central Park or a subway stop" (Clarisa, Time 1).

> "I was here when I was 16 and I remember from then, but I mostly remembered isolated landmarks like the Empire State Building and the park and a few other sites. I remembered the subway and the subway map also" (Judy, Time 1).

This representation of New York was frequently used to get from the Graduate Center to Union Square and from there to Washington Square, which were routes in areas that correspond to the general street system of Manhattan.

> "We'll continue to walk south on Broadway, as we did to get to Union Square. We'll get to Washington Square eventually" (Ross, Time 2. First time on route).

> "The subway map stays more or less the same, so that map from when I was 16 was still helpful to read and even to orient myself on the streets, like

> when I first came to the Graduate Center, I visualized that map and thought I had to go up" (Judy, Time 1).

Most participants could not use this mental representation to get from Washington Square to Angelika, an area that does not follow the general street system. For *many* it was the first time walking there so they had not yet developed an understanding of the zone or incorporated its characteristics into their template of the city.

> "From here (*Washington Square South*) on, I really can't tell... I don't have a map of this area at all... I think west of here streets have names and that's confusing" (Judy, Time 3).

> "I would need to use a real map to get there because my personal map doesn't work. I don't know that area yet... or just try to continue going south and see what happens. I think I'll do ok" (Mary, Time 2. First time on route).

Use of the immediate environment

My results indicate that people use various elements of the environment as aids to wayfind. Some of urban elements are designed to aid navigation, like street signs and maps, but others are not (such as squares and advertisements), and yet people still utilize them as orientation and navigation aids.

The elements of the environment that participants encountered from the Graduate Center to Union Square were used by *most* to reinforce or confirm previously made decisions for getting to the destination. As previously indicated, these decisions involved mainly the use of an existing template and inference.

Things like street signs indicating the street number were only used to verify that the decision of going downtown was being implemented correctly.

> "We're going to walk down Fifth Avenue. I know the way. (*She has decided on a route and starts walking on the east-side of Fifth Avenue after turning left when exiting the Graduate Center... she does not say much and we cross 34th* Street.) We're coming from 34th and this is 33rd (*reading and pointing to the street sign*), so we're going downtown (*it's almost as if she's not reading the sign or using it. She's only showing me that this is 33rd Street as to show me we're going the right way to down-town*)" (Clarisa, Time 1).

> "Even when I'm not paying attention, sometimes I notice that I'm checking out a street sign to see if I'm really going the right way. It has happened to me that after a couple of blocks I realize that I'm going the wrong way" (Dean, Time 2).

Because *most* participants were less familiar with the Union Square-Washington Square segment they used environmental elements such as signs and openings in the streets pattern with trees (i.e., a square) not only to verify the implementation of a route, but also to reassure them in their selection of it.

> "(*As we approach 8th Street, I can see that he's looking around more and slowing down a bit. It seems that he needs more information from out there to make sense or complete the information he has and reinforce his previous decision of walking down Fifth until the arch... He's trying to see far away, the end of the road... even steps on his toes and leans forward.*) I can see the arch at the end of the road. As my friend said, Washington Square is at the end of Fifth Avenue. (*Once he secures the destination by pining visually, he speeds up again. He starts talking about a different experience at this point.*)"

> "I'm looking for an opening... an opening with trees and green, like a square. Once I see some trees, I'll know we're right" (Mary, Time 1).

On the Washington Square-Angelika segment *all* of them relied heavily on environmental information to navigate and decide on developing a route.

"(*We are walking on the street that is the continuation of Washington Square East below Washington Square and the NYU buildings, which we just left behind. She already told me that she's not sure of how to get to the Angelika but that she'll walk down south and try to figure it out. Before, she mentioned being more or less familiar with Houston Street so perhaps she'll recognize something as we approach... she's walking silently, slower that before, and she's looking around both ways on each cross street as looking for cues. I can see that she's reading the street signs and even trying to read signs from parallel streets as we cross a street and looking up to see advertisements and buildings. The fact that she's not talking makes me think that she's thinking and making connections between what she knew, like having Houston somehow located in her representation, and what she's experiencing*). It (*pointing at the street sign*) says W3, so I guess it's the west equivalent to 3rd Street, if there's one, and we're getting closer to SoHo" (Mary, Time 3).

"I'm trying to find a street sign for Mercer. Something that tells me that I'm going right, that I'm doing correctly what the map said. I need to be comparing the map (*he has it in his hands*) to the real thing" (Dean, Time 3. First time on route).

Participants also actively incorporated environmental elements into their template or map of the city while navigating.

"(*Jack talks about the city and the physical elements continuously as reporting to me everything that he sees and how it's meaningful to him. On the previous two segments, though, he was referring to previous experiences or even telling me stories, now his comments regard immediate information that he's finding useful. I think, to build a representation and reinforce his route decision to get to the Angelika.*) These buildings to our right are like a modernist project... I didn't know they were here and now I know (*Exactly. He just incorporated this information to his map*)" (Jack, Time 3, On Mercer and West 3rd).

"I remember the coffee place we came to the last time. I can tell you without doubt that it's right before 17th Street on this side of the street" (Dean, Time 2. Second time on route).

Map making

Map making refers to the addition of significant elements to the city archetype template, which become more elaborate and specific through time. In certain instances, especially in a more complex environment like the area encompassing the Washington Square-Angelika segment, map making is heavily used for wayfinding. In developing knowledge of the city, people incorporate their direct experience to their existing template.

All this information is stored in memory and is retrieved when needed. New experiences and information are added to this template at all times and become part of the memory to be retrieved in the future.

Results indicate that when maps exist, they exist either by virtue of three factors:

(1) Prior self-built knowledge (i.e., mental representation). *All* participants used knowledge they had prior to the first interviews and/or acquired between interviews when finding their way.

> "This is more or less the same as uptown, except that the streets are not numbered. At this point, they still follow a grid, more or less" (Rob, Time 3. First time on route. On Mercer and West 4th).

> "I know that there's an ATM one block down because I got cash from there the other day" (Jack, Time 3. Second time on route).

(2) Conventional maps (e.g., a map of the subway that may or may not equate to the street level). *All* participants used their representation of the subway map as an aid to wayfind on the street level.

> "I know there's a subway station there, on 14th Street. It's called Union Square, right? So that's were we are going" (Dean Time 1. First time on route).
>
> "When I think of New York, I think of something like a subway map. Even though it's far from perfect, it helps me locate things or think of a route or a way to get somewhere, even if it's only the general area" (Mary, Time 2. Second time on route).

(3) Mediational tools (the presence of a physical map). *Two* participants encountered an actual map on the street as they were getting from Union Square to Washington Square. Both used these maps to locate the destination.

> "(*I can see a map of the area there in the corner. Apparently she does not see it. Now she saw it too and walks toward it.*) OK, so here's a map... and now I will know that Washington Square is west of Broadway (*she's looking at the map and following the street in the map with her finger until her finger reaches Washington Square*)" (Clarisa, Time 2. First time on route, at the corner of Broadway and Waverly).
>
> "When I came to visit campuses, I remembered there were a bunch of NYU maps around here, so it's just a matter of finding one of those maps (*she's looking around as we're in the corner of Washington Square East and South... she sees one and we walk on that direction. She rushes*). (Judy, Time 2. First Time on route).

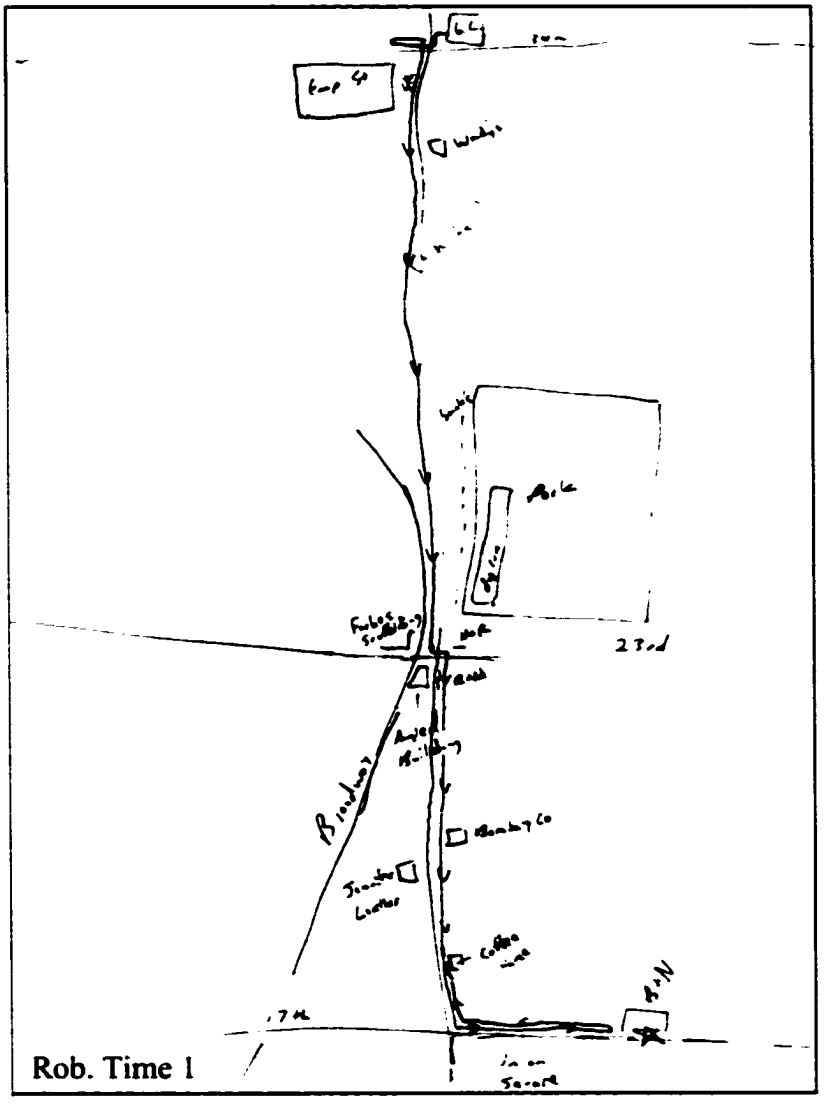
In areas where prior knowledge or relatable other maps can be assumed to be "in mind" the map making activity can be subsumed under wayfinding activities and only surface around the problematic areas of the route. This is the case of the Graduate Center-Union Square and Union Square-Washington Square segments.

When sketching a map of the first segment, participants added information and detail to the existing map of the city at the problematic point of 23rd Street. Once the decision of continuing on Broadway or on Fifth Avenue was made and implemented, *most* participants incorporated that point on their map of the city.

"I know from last time which way I need to go. Last time I considered going down that way (*pointing west, towards Broadway*), remember? But I chose Broadway and ended up on the right place. I know it was here where I had trouble deciding and I won't forget" (Judy, Time 2. Second time on route).

"(*We are approaching Madison Square on our left. Corner of 26th Street and Fifth Avenue. He looks around more and slows down while continuing with his conversation about movies. I'll ask: What are you paying attention to, or looking at?*) I know that Fifth Avenue and Broadway merge at this point (*23rd Street*)... I think it's called Madison Square (*as he says this, he's still looking around and now he's reading a sign on the left that says Madison Square Park, he points at it and nods)*" (Jack, Time 1. First time on route).

Figure 9. Rob's map of route 1



On his map of the first route, Rob represented many elements around the problematic of Broadway and Fifth Avenue and not as many elements between the Graduate Center and Madison Square. The latter elements include city landmarks, such as the Flat Iron building and subjective landmarks, like the Forbes scaffolding, the dog-run or subway stops. Note the mistaken representation of

Broadway skewing west and Fifth Avenue continuing towards Union Square. It was not until the third interview that he corrected this mistake.

On the Union Square-Washington Square segment the existing map was only modified to include street names or to re-adjust the template with direct environmental information that had not been previously experienced. In this segment the problematic was how to continue south in the direction towards Washington Square. Once participants made the decision, the experience and environmental details were incorporated to the map. The decision at this point was made through inference, template and the environment.

> "I'd walked down this street (*University Place*) before but I though it was Broadway. Now I know it's called University" (Clarisa, Time 2. First time on route).

> "Although I'm not sure, I am pretty sure that this street (*University*) will take us there. I've walked down here a couple of times and although I don't know, I think Washington Square is the square down there to our right. Now I'm sort of mapping it out" (Rob, Time 2. First time on route).

Results indicate that spatial behavior and activity change as areas become more problematic, specifically when new decisions need to be made in these problematic areas. Data shows that in areas where prior knowledge could not be used –that is, when the template did not apply to the new environment- map making and mapping activity became more visible. This is supported by participants' patterns of wayfinding from Washington Square to Angelika Film Center. Incorporating environmental information of the area into the map became an active process that enabled navigation and, at the same time, resulted in

building of maps to be used on future expeditions. When the area is unknown and the existing template does not apply, people must develop a map in order to pin down the destination. People actively build this map by exploring, looking at an existing map, or asking.

> "Ok, so here's a map (Corner of Broadway and Waverly) and now I will know that Washington Square is west of Broadway" (Clarisa, Time 2. First time on route).

> "There's no other way to learn than to explore and that means sometimes you have to get lost, but you have that information and it won't happen again. Next time you know" (Judy, Time 3. First time on route).

All participants built a mental representation of a map of the most problematic segment, the Washington Square-Angelika segment, as they tried to find their way. Developing a map that incorporated as many environmental elements as possible –including street signs and physical features of the landscape- was both a strategy for, as well as a result, of wayfinding.

> "(*We're walking diagonally across Washington Square. Judy decided to explore and try to find her way to the Angelika, on Mercer and Houston, by walking around. It seems to me that she takes this as a fun challenge and she likes exploring. She's walking in the wrong direction, though, since she's walking south-west of the park instead of south-east.*) I think I might find my way if I go to the end of the Square and see some signs... I even might recognize some streets or something... I think I might make sense out of it...(*As we come back on the south end of Washington Square, she's trying to fix her mistake and make up for lost time, so she's walking pretty quickly.*) OK, so from this point on, apparently there are no numbered streets... at least not to the west of the Square" (Judy, Time 3. First time on route).

> "OK, so putting Washington Square together with the rest of the information, I can place it west of Broadway and east of the official (*he makes the hand gesture of quotes when he says official*) west side" (Jack, Time 3. Fist time on route).

In the following example, Rob has some information about the area, which is not enough to locate the destination. By actively exploring, he incorporates information to his existing representation and at the same time, he gets closer to the destination.

> "I know Broadway is to our left and then there's a bunch of NYU buildings. South of this... I don't know, so let's go find out (*As he says this he continues to walk south, slightly west. He is not talking now and it does not seem he's looking for information at this point... We are on the south side of the park and he stops, turning right and then left. He starts walking east*)" (Rob, Time 3. First time on route).

Figure 10. Mary's map of Union Square-Angelika route

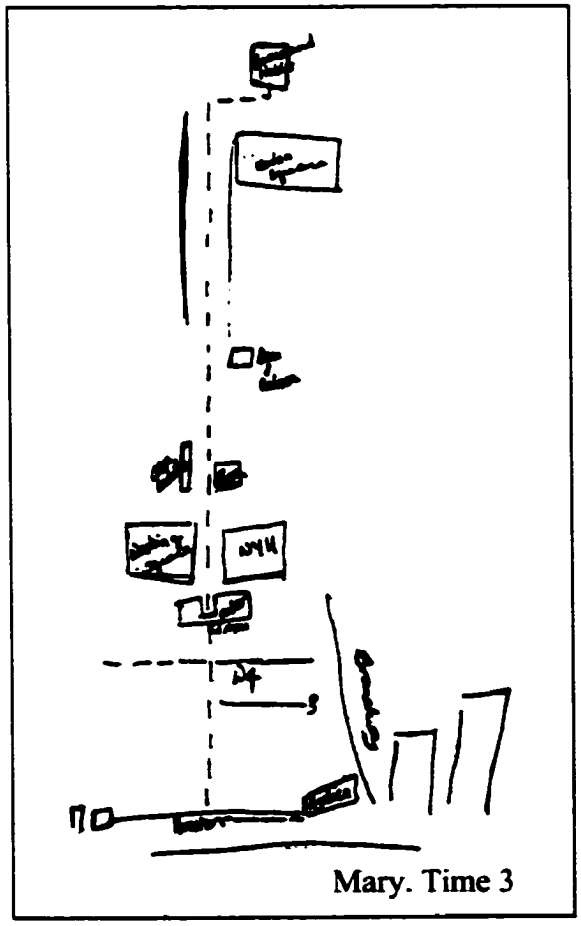
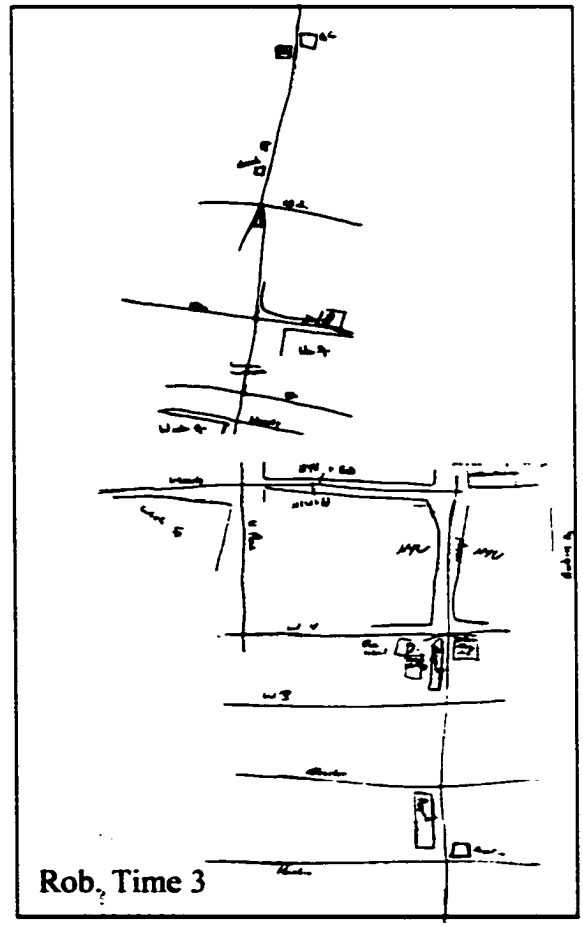


Figure 11. Rob's map of Union Square -Angelika Route



These two sequential or route maps include information acquired during navigation of the route for the first time with me (and including prior experience in the area). In an unknown problematic area that does not follow the general city structure, developing a map of the area and route depend largely on direct experience with the environment. This implies that maps are not only spatial elements represented internally but are also important for decision making, and therefore closely related to action plans and activity. Thus, what participants represent in their sketches are elements they experienced for the first time and that may be used in future navigation as a wayfinding tool. For example, Mary decided to continue walking south on Washington Square East, passing under the NYU buildings that are represented in the map (see "under"). She also recognized a broken cash machine that we saw and the few streets that she referred to in street signs. The spatial context she provided is given by the buildings in the crossing of Broadway with Houston, east of the Angelika, which she knew and was able to identify when we got to our destination.

Different from Mary's route-map, Rob's map is spatial. It integrates elements he experienced for the first time, like the NYU buildings (see "yellow, blue, red") and the playgrounds on Mercer and West 4th and between Bleecker and Houston respectively.

These wayfinding strategies configure and reconfigure in different ways depending on: (1) the characteristics of the route, (2) the "problematic" of space at any given point of the route, and (3) the segment-task-environment relation.

The complex nature of maps and map development was shown in the way participants drew their route sketches, especially after we had traveled a route for the first time. After the wayfinding task, we sat (at a coffee shop or inside the Angelika) and participants were asked to draw the area and route we had just walked. Participants showed different sketching styles. While *some* started by drawing a template of a spatial map to which the actual route path was added, others had a more "activity based" approach and drew the route as if they were *re-walking* it, adding spatial elements such as landmarks, streets, or corners to the path. As a result, maps sketched by participants varied in size, occupying from half a letter size page up to 6 letter size pages[1]. Their simultaneous verbal descriptions of the sketching task reflected the same style described above. Those who drew a spatial map first, described the spatial elements and then the path walked, whereas those who started directly with the route described mostly actions. This indicates that people were developing and rearranging a representation not only as they were walking the route or area but also as they were drawing/sketching it. The mental representation of space, both in spatial and sequential form, is fluid; different elements emerge as people try to reorganize this information and decide either to navigate or to draw a map. The characteristic and problematics of the routes (described in Chapter III) are summarized as follows:

[1] All maps were scanned and formatted to fit one page. All are included in Appendix 3

Summary table of route characteristics and problematics

Segment	Characteristics	Problematic
Graduate Center to Union Square	Rectangular grid with numbered streets and avenues. Diagonal Broadway presents a conflict between the route and the general NYC logic.	Intersection of Broadway and Fifth Ave. at 23rd St. What do I do with a diagonal? How do I continue on the right direction towards Union square? Correct answer: Choose Broadway south of 23rd street.
Union Square to Washington Square	The route crosses the relationship between NY general pattern and no-pattern. Broadway is a continuation of old pattern, affording a continuation between pattern and no-pattern.	Parallel streets lead to Washington Square: Fifth Avenue and University Place. Which way leads south/Washington Square? 2 correct answers: University Place and Fifth Ave. Common error: Broadway.
Washington Square to Angelika Film Center	Area does not follow general city pattern. No grid or number system.	Unknown/No template. Lack of grid and numbered streets. How do I fix a point in space and a template? Solution is to develop a map through exploration or use of other map. Common error: Stick to general NY template (does not apply).

Each particular wayfinding strategy holds a relationship with the route segments' characteristics and problematics as summarized in the following table:

Summary table of wayfinding strategies per segment

Strategy	Segment 1 Graduate Center - Union Sq. NY pattern Broadway diagonal	Segment 2 Union Square. – Washington Sq. Transition NY pattern to No pattern	Segment 3 Washington Sq.- Angelika No NY general pattern
Inference	Grid. Numbered streets indicate downtown.	Grid system continues. Continue walking south.	Does not apply.
City archetype	Assumption of the elements of New York City being the same as any other city (e.g., streets, blocks, sidewalks, signs, street lights.)		
Mental representation	Grid. Use of subway map and landmarks.	Subway map less clear. Use of landmarks.	NY existing template does not work.
Environment	Used mostly to reinforce previous decision and current actions.		Used to build a map.
Map making	Only at problematic points.	Incorporate some environmental elements to map.	Need to be developed through experience or a map.

III. Development of the wayfinding strategies

Each participant performed the Graduate Center-Union Square and Union Square-Washington Square segments twice in Time 2 and Time 3. The Washington Square-Angelika Film Center segment was performed only once.

Navigating the first two segments twice allowed observing repeated trials and lead to repeated qualitative data, which allowed comparisons and illustrated the changes in use of wayfinding strategies due to experience and familiarity. It is

important to note that participants had different degrees of exposure to the routes between each interview, but all participants had navigated these routes at least once (on the previous interview).

Changes in wayfinding strategies and transformation from wayfinding to waydoing due to experience were observed in the data in three ways. First, the patterns of participants' actions described in my commentary notes changed through time. Comparisons of activity/behavior on the same segment of an area at different interviews show a tendency from more attentive behaviors (e.g., walking slower and looking around apparently seeking for information) to less attentive ones (e.g., chatting of topics unrelated to the task) over time. Second, participants' speech reflected less use of environmental elements (such as signs) through time. For example, the second time Rob and I navigated the Graduate Center-Union Square segment, he said: *"I don't even need to check on the street signs now because I know exactly what's going to happen and where I am going."* At the same time, the lack of reference to these physical elements or the use of cognitive strategies (such as mental representations or inference) indicate that these strategies were not present. Third, a change in the mental map was observed through participants' representation (drawn maps) of the areas and route-segments. Examples of these transformations in people's maps are given in the following section.

A. From wayfinding to waydoing

The strategies involved in wayfinding and the way they interact with each other as people navigate from one point to another have been described previously. Participants employed different strategies at different segments of a route, depending on its characteristics, problematics and the way the environment channels behavior and action. Results indicate that there are also changes in the use, interaction, and integration of these strategies due to repeated exposure, resulting mainly from familiarity with the route. That is, as people navigate a route for the second and perhaps subsequent times, significant changes in their wayfinding behavior occur. This finding supports the interactive and developmental nature of the spatial cognitive repertoire of strategies.

Participants' behavior and speech at problematic points best illustrates the transformation of wayfinding into waydoing. While analyzing the data, I identified the most significant patters of wayfinding action across participants in the problematic areas on the 23rd Street-Fifth Avenue intersection, the continuation towards south to Washington Square from Union Square, and locating the Angelika Film Center on Mercer and Houston. My commentary notes as well as participants' speech and sketches illustrate this transformation.

My commentary notes were valuable data reflecting participants' actions. Participants' speech did not always include data related to wayfinding, since people were involved in the task -- they did not talk about wayfinding because they were finding their way (See Clancey, 1993). At the same time, when

participants were not wayfinding (e.g., mostly in non-problematic areas), they engaged in other activities reflected in their speech (e.g., talk about non-wayfinding related things). The lack of reference to information related to wayfinding was valuable data in itself since it shows a transformation from more attentive processes to less attentive ones.

It is relevant to note that participants' behavior and performance were affected by the interview. *All* participants reported that they were more attentive of their surroundings and more aware of their performance as a consequence of being interviewed, likely resulting in better, faster, and more accurate learning of the surroundings on these routes.

Participants' speech, my observation of their actions, and their maps reflected a change in wayfinding patterns from more attentive, decision-making cognitive process, to more embodied, less conscious and less attentive ones. Apparently, as knowledge of an area increases, the need to wayfind decreases, resulting in what I have described as waydoing. I define waydoing as a navigational behavior that occurs when cognitive structures give way to a more embodied, less attentive behavior in space when getting from point A to point B. Embodied behaviors are embedded in the mind-body-environment system (i.e., action system) rather in a symbolic processing central (i.e., an abstract mind as suggested in symbolic processing approaches).

The development of wayfinding into waydoing goes through a transitional stage that I have called "cruising." Cruising is a more embodied and automatic

behavior than wayfinding but involves some degree of internal cognitive processing (correcting a mistake in the plan, for example) when walking a route. Because of the structure of the city, Manhattan channels a lot of cruising when navigating a route even for the first or first few times. Cruising happens if the journey needs to be remembered when walking a planned route. Although *most* participants did not specifically talk about cruising, I observed them walking and paying attention to no-wayfinding related elements or talking about unrelated issues (i.e., chatting) and suddenly redirecting their attention to the wayfinding task and relevant environmental information. This was especially noticeable in the problematic areas, when new decisions needed to be taken, or when the pattern in the environment changed.

> "I'll continue walking down until I hit the [Washington] Square. (*Clarisa said earlier that she was going to walk down Broadway to Washington Square, but she's about to take University Place. She doesn't seem to realize that that is not Broadway. We are crossing 14th Street on the west corner of Union Square.*) There's not much more to do at this point, so we can just talk or whatever (*We are not on Broadway.*). Wait! This is not Broadway anymore... Let me see the name of this street... *(She is looking around*) this is University, ok (*read in a street sign*) I believe we can continue on this street and still get there (*she changes topics after having decided her path*)" (Clarisa, time 2. First time on route).

> "I'll walk down until we get to 14th Street. There I'll look for Barnes and Noble. I guess it will be easy to find, but at this point there's nothing else to report (*we are walking down Park Avenue and Dean really does not pay that much attention to things around him. Before he mentioned something about a building he likes and that's pretty much it. As we get closer to Union Square, we are on 18th Street, he looks around and points towards the square*) You see, this is where I told you there are circles on the floor. We're almost there" (Dean, Time 1).

During cruising the person may decide not to think of or pay attention to the environment for a while, but there is still some degree of awareness of it. This awareness brings environmental input that reinforces the situated actions and allows for correction of mistakes (for example, an error in the planned route such as taking the wrong street to get to the destination). *Some* participants said that after making a decision on a temporary plan, they were able to deviate their attention from the task until new information from the environment was needed.

> "Here I want to see if we passed 8th Street... I'm looking for a sign because it [Washington Square] cannot be too far south (*As he says this, he's trying to locate a street sign, which he does now and continues walking.*)" (Dean, Time 2. First time on route).
>
> "You might think that I'm not paying attention at all, that I'm only telling you all these stories, but I have one eye on what's out there. Maybe I see something useful on the way" (Jack, Time 3. First time on route).

Waydoing happens after repeated exposure to an area or route –when a person is completely familiar with that area and does not need to pay attention to the environment in order to get to the destination. No (or very limited) internal cognitive processes or strategies are involved in the task. The persons' mind may wander as the body is taking her/him there.

1. From wayfinding to waydoing the Graduate Center-Union Square route: The "23rd Street-Fifth Avenue Intersection" Problematic

Time 1

My results indicate that there are two main decision-making points in the Graduate Center-Union Square route. Participants made the first decision when leaving the Graduate Center, as each one chose which road to take. *Most* participants chose Fifth Avenue by making a left when exiting the building and proceeding towards downtown and then reported their choice when prompted.

> "I just continued walking on Fifth because I know it will take us south... that's my strategy: to walk down on Fifth Avenue" (Judy, Time 1. First time on route).
>
> "Fifth Avenue is the most direct way. Or maybe not, but from here, that's the way I'm going to go" (Rob, Time 1. First time on route).

The second decision-making point was located at the route's problematic, encountered on the merging of Fifth Avenue and Broadway at 23rd Street. *Most* participants reported paying attention to any environmental information that helped them identify the correct alternative leading to Union Square.

> "(*As we approach the corner of 23rd Street, she slows down even more and looks around. She also looks down Fifth Avenue and down Broadway as if trying to decide which way to go*) I'm looking for a street sign... I'm not sure which way to go. OK, there's a sign that says 'Fifth Avenue that way, Broadway this way (*At the end of the triangle between the intersection of the two avenues. There's a small sign indicating that Fifth Avenue continues on the right and Broadway on the left and that's what she's looking at*)... but I am not sure if we're going to end up west of Union Square" (Judy, Time 1. First time on route).

> "(*We find ourselves walking between Broadway and Fifth Avenue, since Rob crossed the street on 25th Street, but stayed in the middle of the way, on the small sidewalk that divides both avenues. It feels awkward to me to be here, since we're approaching 23rd Street and the sidewalk is getting more and more narrow*) I didn't plan to end up here. I didn't know we'd end up in the middle of the street, and now I need to know if it's best to cross to our left or to our right, so I'm trying to find some type of information" (Rob, Time 1. First time on route).

At the same time, *some* participants' speech suggests the use of mental representations (some rudimentary, some elaborate) of the city to locate and identify the most direct route to the destination from this point.

> "If Broadway is a diagonal, maybe it will take us closer to Union Square. I thought it was Fifth Avenue the one that goes down there, this way (*As he says this, he's moving his hands and arms in the direction he refers to... we cross 23rd street walking faster than the group of people waiting for the light.*)" (Rob, First time on route).

> "I want to guess that one of the squares connected by Broadway is Union Square, so it's a clue that helps me take Broadway and not Fifth" (Jude, Time 1. First time on route).

In these examples, Broadway is referred to as a diagonal path that might intersect with Union Square and is located on the square in reference to Fifth Avenue. The way *all* participants put together city elements in meaningful ways suggests a degree of mental organization of spatial information that serves as a wayfinding strategy. I refer to this cognitive organization of spatial information as mental representation.

In the following example, Dean's speech reflects his choice to walk down Park Avenue as he decided his route by means of the subway system information incorporated into his mental representation.

> "There's a [subway] stop at 14th Street called Union Square. I usually take the 6 train there to come to the Graduate Center and that runs on Park, so I'll take the same route backwards" (Dean, Time. First time on route).

Additionally, my results indicate that participants actively incorporated the complex environmental information of the problematic into their mental representation of the city. In the following examples, data from participants' speech and my notes on their actions reflect that new environmental information, specially at problematic points, stands out as relevant for wayfinding as it is integrated into the mental representation of the area.

> "(*As we're in the area of the intersection of Fifth and 23rd Street, he talks a lot about what he's experiencing, what he sees and the way the new information matches what he already knew. He's questioning some of this old information, like the belief that Fifth Avenue continued diagonally towards east.*) I know Broadway runs diagonally, although I didn't know they merged at this point... or maybe it curves, I am not sure... Good thing is that now I'll now the right way down" (Rob, Time 1. First time on route).

> "(*As all the other participants, Jack is doing a lot of talking at this point [24th and Fifth Avenue], referring to the things he sees. He's looking around. He pays attention to the dog run and get closer to the park, walking diagonally to get closer to the grass and far from the street.*) So this is Madison Square (*reading a sign*), which is probably east of Madison Square Garden, right?... I'll remember the dog-run here" (Jack, Time1. First time on route).

On Time 1, *several* participants did not know that by staying on the left side of the street, they would be taking Broadway south of 23rd, after walking on Fifth Avenue from 35th Street to 23rd Street. They assumed that they were still walking on Fifth Avenue.

> "I'll just continue on Fifth Avenue. There's no reason to cross the street that way (*pointing west*)" (Mary, Time 1. First time on route).

> "Last time we walked the same way down Fifth Avenue and ended up in this same place" (Rob, Time 2. Second time on route).

Results also indicate that once new decisions at problematic points were made and the problematic was left behind, the environment was used only to reinforce the decision on how to get to the destination. When approaching the destination, participants actively looked for environmental information such as street signs or trees.

> "I just want to confirm that we haven't passed 17th (*looking for a street sign*) Street so I'll see what street is next" (Judy, Time 1. First time on route).

> "I'm looking for an opening in the city that will indicate a square and also trees... there are some trees (*19th Street. as she says this, she stands on her toes and tries to see over the shoulder of the woman walking ahead of her. She leans to one side, towards the street, to see further down*)" (Mary, Time 1. First time on route).

Time 2

Important differences were observed between people's actions and decision- making processes when navigating the Graduate Center-Union Square route in time 2. It is important to note that these differences may be partly due to the interview itself and participants' interaction with me. The transition from wayfinding to cruising to waydoing was identified through participants' speech, my commentary notes, and maps/sketches. *All* participants had repeated experiences with this segment between interviews 1 and 2, which increased their familiarity and accurateness.

No decision needed to be made when leaving the Graduate Center. *All* participants automatically turned left towards downtown, applying their developed map to the task of getting to Union Square. Nevertheless, I observed awareness in *all* participants to physical elements such as street signs that provided information to reinforce the implementation of the decided route (i.e., cruising).

> "From here on, it's easy. I know what I'm doing so I don't have to pay attention. (*We are on 34th Street and Fifth Avenue. One block down, after he said he doesn't need to pay attention, I see that he's checking on a street sign*)." "(*As we get closer to 26th Street, to Madison Square, he looks around more, he's reading the sign at the entrance of the park and checking out the street signs.*)" (Dean, Time 2. Second time on route).

> "It's more like an auto-pilot mode. I'm just walking and watching people and shops and talking to you. (*We're getting closer to Washington Square, we're on 12th Street and University Place, and she's talking about a shop that she likes, she points to the trees to our fat right in the park as indicating our destination.*)" (Clarisa, Time 3. Second time on route).

Besides, participants added to their mental representation as they were walking. *Most* of them referred to elements they believed they would remember or said they recalled elements from previous experiences.

> "OK, so I knew that Broadway and Fifth Avenue meet at 23rd Street. I will now remember the ad and the funny building (Flat Iron Building)" (Mary, Time 2).

> "I told you, I remember the circles on the floor from one other time I walked around here with some friends. (*I find it interesting that he remembers the circles over any other thing in Union Square.*)" (Dean, Time 1. First time on route).

The problematic point of Time 1 was not problematic at Time 2, since participants had learned the solution. *All* participants chose to walk down Fifth

Avenue and continued walking on the left side of the street south of 23rd Street, on Broadway towards Union Square.

> "Last time I learned to go this way. I made the right decision then and it worked. Now I stick to that route. (*I can tell that she's less attentive to the surroundings than last time. It's as if she wanted to proof to me that she knows the right way by walking fast and confidently through the 23rd Street-Fifth Avenue intersection.*)" (Judy, Time 2. Second time on route).

> "This time I know for sure that this is the shortest way. I tested it last time" (Rob, Time 2. Second time on route).

Most participants' had updated their mental representation of this area by Time 2. At this point, *most* of them knew that Broadway ran diagonally and intersected with Fifth Avenue.

> "I know from last time that this intersection happens at Madison Square and that Broadway is the most direct route because it runs diagonally west to east." (Jack, Time 2. Second time on route).

Two participants were not clear regarding which the direction in which avenues passed.

> "As the other time, we came all the way down on Fifth Avenue until we got here [Union Square](*This is not Fifth Avenue. He still hasn't learned that it's Broadway that runs diagonally.*)" (Rob, Time 2. Second time on route).

> "You know? I don't think I'm sure this is actually Fifth Avenue. It might be Broadway" (Clarisa, Time 2. Second time on route).

2. *From wayfinding to waydoing: The Union Square-Washington Square route: The "How to continue going south" Problematic*

Time 2

The Union Square-Washington Square route presented a transition between the general pattern of the city and the lack of a structured pattern. The street system changes in various ways: from numbered grid to unnumbered; from grid to no grid; and from numbered to named streets. The problematic of this route was to determine which street to take if continuing south, without having the support of the general pattern (numbered streets in a grid) of the city. The options were University Place and Fifth Avenue, the first being the most direct alternative.

Similar to what happened when the first destination was given to participants, deciding a route to Washington Square occurred at the moment when I told them the destination when we were at Union Square. *All* but one participant knew or at least had an idea that Washington Square was south of where we were and decided their general plan of action based on this knowledge. The plan for *all* of them was "to continue going down." To implement this decision of going south, and because of the nature of the setting at this point, the centralized cognitive wayfinding strategies of inference and use of mental representation were not frequently employed by participants. Although *most* knew which way to continue going south –they had been walking south from the Graduate Center- they needed to reinforce their decision using other wayfinding strategies, like

physical elements (a sign, for example), the use of a physical map, or asking other people.

> "I'll need to ask someone because I have no idea where Washington Square is (*He's looking around, almost as if he was acting out as being lost or clueless. He's trying to find a person to ask*)." (Dean, Time 2. First time on route).

> "(*After I give him the destination, he stands still and looks around and turns towards Barnes and Noble.*) I'll go inside the bookstore and find the Square in an actual map and then follow the route. I don't think it's far from here, and I know it's south of here" (Jack, Time 2. First time on route).

By the time we walked together to Washington Square, *all* but one participant knew from prior experience that Washington Square was south of Union Square and kept walking in that direction. *Most* of them did not know in advance the name of the street or which street they were supposed to take, but kept going in the right direction, *most* of them on University Place. This instance exemplifies cruising, since in order to get to the destination people had to pay attention to environmental cues (e.g., signs, NYU flags, trees) after making a general decision on direction.

> "We'll just keep going south that way (*pointing at University Place as she walks on that direction*). We might get there, or find some cues that will tell us where to go" (Mary, Time 2. First time on route).

> "I'm going to be attentive just in case, but I think we won't have a problem in getting there" (Jack, Time 2. First time on route).

It seems that participants who decided to keep walking south, –even without knowing exactly where the destination was- ended up taking the most direct route, University Place. *Some* of them had previous experience in the route

and others figured out a convenient route using other techniques (e.g., inference, archetype). For example, the *two* participants who did not know where Washington Square was, and who used other strategies like asking or a map, decided to take Fifth Avenue.

Participants' strategy for both alternative routes involved walking south until useful environmental information was found or a new problematic that required new processing was encountered.

> "OK, so it's all the way down Fifth Avenue. We'll try to get there and if we don't, we'll ask again" (Dean, Time 2. First time on route).

> "At least I know we have to go south, so we can start walking that way (pointing south) and try to figure it out on the way. We'll find it" (Jude, Time 2. First time on route).

A few participants knew ahead of time what type of environmental information they were looking for, since it usually included elements related to NYU and open space.

> "I know NYU (*He told me before he came to NYU before, when he applied to college, so maybe that's how he knows the area.*) is spread around that area, so I'll look for NYU flags" (Jack, Time 2. First time on route).

> "Washington Square is sort of part of the NYU compound, so that's why I can see all the purple stuff like flags" (Judy, Time 2. First time on route).

Data also supports the use of a city archetype in which squares are open spaces in a city, usually with trees or vegetation.

> "Again, it has to be an open area with trees... that's what I'm looking for" (Mary, Time 2. First time on route).

> "I can see trees there, to our right, so the square is there. Now I just need to confirm that it is the right one" (Clarisa, Time 2. First time on route).

Once people decided on an action or route, they seemed to pay less attention during the wayfinding task, using the environmental information along the way to reinforce their decision.

> "It's the auto-pilot mode again, at least until we get to 8th Street. There I'll do a new evaluation (*As soon as she says this, she shifts her attention to our conversation, not related to the wayfinding task. As we get closer to 8th Street, we're on 10th Street now, she starts looking around more and slows down a bit.*)" (Judy, Time 2. First time on route).

> "I feel like I can just talk to you and not pay attention (*but as he says this, he's still looking around and checking out street signs*)" (Jack, Time 2. First time on route)

Mapmaking at this point consisted mainly of connecting Union Square to Washington Square. As will be detailed in the following section, not many elements were represented in people's maps of the area. The focus appeared to be on how to connect two squares, rather than in mapping the information between them.

Time 3

When participants navigated the Union Square-Washington Square route for the second time, *all* except one went down University Place. One person followed his first route, down Fifth Avenue.

Similar to what occurred during the first route-segment, the more centralized cognitive strategies of inference, use of mental representation (although not always used as successfully as on the first route), and even the use of

environmental elements as an aid for wayfinding were substituted first by cruising and eventually by waydoing.

> "(*As soon as I tell him where to go, he starts walking with confidence, diagonally from Barnes and Noble to south-west of Union Square*) I know perfectly well how to get there. Although I won't use Fifth Avenue this time, I don't need to pay attention because I've walked down this way" (Jack, Time 3. Second time on route).

> "(*Clarisa does not report using any environmental features today. As a matter of fact, she's hardly paying any attention to what's out there and is telling me about other things*). I had lunch there the other day and it's good" (Clarisa, Time 3. Second time on route).

Segment 3, from Washington Square to Angelika Film Center was only navigated once, so no analysis of repeated trials was performed for this segment.

B. Changes in mental maps

The most prominent change in people's mental maps of the city was a specification from a generic representation of the city (derived from the archetype of city and basic knowledge of New York City) to a more detailed, specific map. As explained in the previous section, through experience map-making enhances the representation of the specific city (i.e., New York).

> "All I knew at the beginning was that Manhattan is an island with a lot of landmarks and rectangular blocks. Now I've learnt a lot about some areas that I like and where the nice stores are" (Clarisa, Time 3).

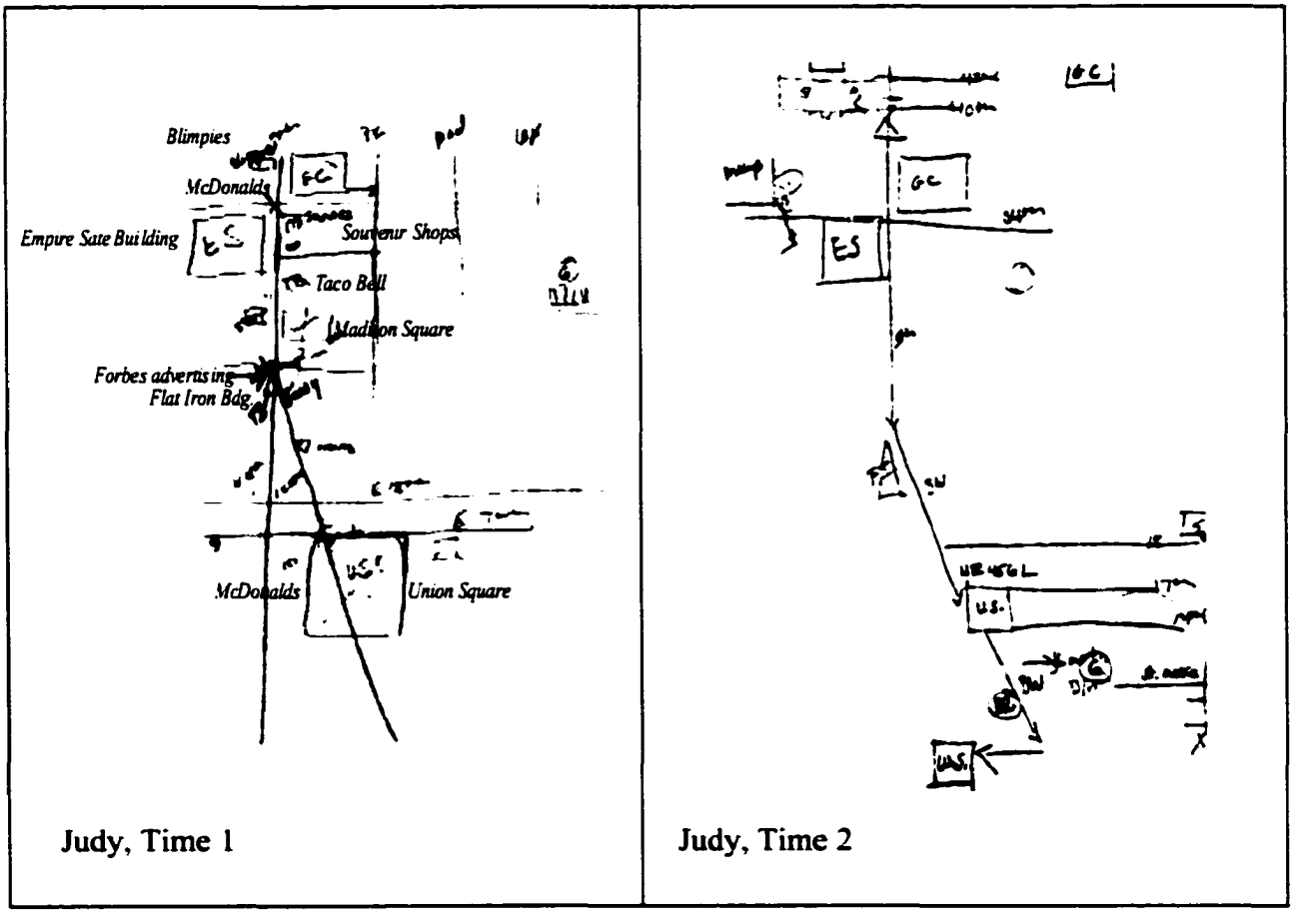
> "With time, I'll now more and more pockets more in detail until I know everything that I want to know about the city" (Jack, Time 3).

It is important to bear in mind that the nature of the task (wayfinding and sketching a map of the route and area) may have affected people's cognitive mapping activity. For example, *many* participants reported that they were overly aware of their performance wayfinding and therefore more attentive to the surroundings than they usually would be when walking the same route without being part of a study.

A comparison of the three sets of route map-sketches of the first and second segments shows a consistent decrease of environmental elements in the maps from interview to interview. Moreover, there are fewer elements represented in the already familiar segments of a particular route, especially at decision-making points and problematic areas. My interpretation of the tendency to represent less physical elements in maps through time is that these elements simply become less relevant in people's ability to get to the destination. When a decision needs to be made by relying on environmental information, the physical elements used as an aid to wayfind are very salient in people's mental representation of the route just traveled and therefore get to be represented in a sketch-map of the route and area. When the route has been learned and the area is known (that is, when people navigate a route for the second and subsequent times) they rely less on using the environment as a strategy for wayfinding. The outcome is the dropping out of these elements from the representation, which can be observed in the fact that participants do not represent these now familiar elements in their maps.

In the following example, Judy's map of the Graduate Center-Union Square segment during Time 1 is detailed. It includes several environmental features, including city landmarks (Empire State Building, Flat iron Building, Madison Square) and subjective/personal landmarks (McDonalds, Wendy's, subway stops, advertisements, movie theaters). Her second map of the same route only includes two city landmarks (Empire State Building and Flat Iron Building).

Figure 12. Developmental change in Judy's maps



Judy, Time 1

Judy, Time 2

This change from more to less represented elements in maps supports my theoretical approach that spatial cognition acts to integrate symbolic processes and situated actions. During the first few times a route is traveled, the symbolic processes emphasized by Vera and Simon are relevant for wayfinding. The cognitive representation of physical elements (represented in a sketch map) is shown as one main strategy of spatial organization and, therefore, navigation (as activity/behavior). Spatial behavior at this point is not embodied in "Suchmanian" terms. These results thus support the use of symbolic processes in wayfinding as a case of spatial cognition and behavior.

On the other hand, as people become familiar with a particular route or area, the physical elements that were originally relied upon for wayfinding become increasingly integrated into the person's general experience and manifested in an embodied knowledge/behavior, as Suchman suggests.

If the symbolic processing approach were correct and spatial cognition was a case of symbolic processing only, people would repeat (on second and consecutive navigations) to represent the physical elements that were relevant on their first wayfinding experience. These elements would not become integrated to a general experience that eventually affords more automatic, less attentive behavior (e.g., waydoing). On the other hand, if spatial cognition and behavior were always mainly embodied, people would not have and use representations of physical elements as an aid for wayfinding at any time.

In this way, two conflicting theoretical approaches (Cognitive Processing and Situated Action) can be integrated and contribute to the understanding of the development of wayfinding into waydoing as a case of spatial cognition.

The following chart summarizes the changes related to repeated exposure:

First encounter ——— **Subsequent encounters** ———→	
WAYFINDING ——— **CRUISING** ——— **WAYDOING**	
Less familiarity	More familiarity
Decision making at problematic points	Problematic points are not problematic anymore. No decision making required
No experience integrated to representation	Experience integrated to representation
No frames of reference	Frames of reference are mapped
More attention to environment	Less attention to environment
More elements represented in maps	Less elements represented in maps

My results suggest that there is a process by which the conscious strategies related to wayfinding are replaced first by less attentive behaviors of cruising and eventually by waydoing. That is, as people get more familiar with an area and/or a route, the process of getting from one point of the city to another involves less symbolic/internal cognitive strategies. The more centralized cognitive strategies include inference (e.g., the use of street numbering system to determine direction), use of city archetype, and the use mental representations (e.g., using knowledge of grid patterns at a points that does not follow this pattern, such as the intersection of Broadway and Fifth Avenue).

The wayfinding strategy of using the environment also changes through time. At first, environmental elements are used to provide information about a

direction (e.g., signs) and to locate a destination (e.g., open space and trees as indicating of a Square). After repeated exposure, people do not seek this type of information, since they have developed a template that allows them to navigate efficiently. The integration of relevant environmental elements into people's city templates –mapmaking process- is explained in the next section.

The results discussed in this Findings section, support my hypotheses that wayfinding consists of a repertoire of processes and strategies including internalized representations of space, situated actions, and use of the environment. Additionally, the results support my assertion that the interaction of spatial cognitive strategies and processes varies over time. The weight and interaction of each one on the process of getting from one point to another varies partly as a function of experience or familiarity.

DISCUSSION

This study has added to the literature on spatial cognition in five ways. First, it has expanded upon the understanding of how people organize and represent spatial information of complex urban environments. Second, it has suggested that people moving through environments can be conceptualized as action systems configured by three continuous and dynamic parts: mind, body, and environment. Third, it has expanded upon current knowledge of spatial cognition by providing detailed research on the process by which adults get to know and use New York City. Fourth, it has supported that wayfinding consists of a repertoire of strategies, including internalized representations of space and situated actions. Fifth, it has shown that an integrated theoretical and methodological approach is the most useful for understanding the dynamics of spatial cognition, especially in relation to how newcomers to a large city learn how to navigate new locations.

In the following discussion section, I place my findings in the larger context of the literature on spatial cognition and draw implications for future research. In contrast to Chapter I of this dissertation, I plan to narrow this discussion to the area of spatial cognition in large-scale environments.

I. The structure of the city

Environmental social science as a multidisciplinary field originally approached spatial cognition from two angles. One focused particularly on the physical elements of the environment --the "spatial" angle (i.e., Lynch, 1960; Devlin, 1976). The other placed its attention more on the people's experience of spatial cognition –the "cognitive" angle. With time, these two approaches have developed into a more integrated one, resulting in the study of the phenomena of cognition of space where it occurs –in the real world/environment.

One school of thought has identified the physical elements and structures that become part of people's representation of the city (Lynch, 1960; Devin, 1976; Kaplan, 1976; Ferguson and Hegarty, 1994; Moeser, 1988; Thorndike, 1982). The limitation of this approach, however, is that it neglects the embodied nature of spatial cognition. It focuses mainly on the effects of the environment and action in mental representations, but does not consider the person as an activity system in space that moves around the city.

The results of my work confirm the relevance of the physical elements described (e.g., landmarks and paths) in people's understanding and representation of the city, but those elements are seen in the context of an embodied mind that acts on and simultaneously learns a new environment.

The city elements described by the participants of my study as relevant for wayfinding coincide with Lynch's in *The Image of the City*, with one major

exception: he makes inter-individual generalizations without acknowledging contextual and personal elements in the process of representation. The city elements he describes are only those encountered at the street level. Yet, people tend to represent New York City in a complex map, often breaking down the city into three geographic levels: the underground, the street, and a more subjective level that offers a "bird's-eye" view.

Results of my study suggest that paths (New York City's grid street system) and landmarks (e.g., Empire State Building) are the main elements used by people when wayfinding at street level. This coincides with Devlin's (1976) findings that paths were the predominant city elements and the most dominant characteristic of the city structure. It also supports Ferguson and Hegarty (1994), who emphasize the value of landmarks for wayfinding. Since paths in Manhattan are streets and avenues, spatial behavior (such as wayfinding) is channeled by the environment. In this way, the environment plays a role in spatial cognition and action, rather than having only a representational value as presented in previous approaches to cognition of space.

These findings are relevant in a theoretical context that considers activity and purposeful behavior as the binding factor between the described physical elements and people's understanding of the city. My findings support Passini's (1984) assertion that spatial decision plans require environmental information. It is only when a person is situated in the city and needs to find his or her way that these elements become relevant and are represented for future use. Furthermore, it is

only through movement that individuals experience more of the environment to be represented. As Wood (1971) suggests, the nature of the representations is intrinsically related to movement.

II. Newcomers' models of spatial organization

The relevance of archetypal knowledge that people have of cities and city structure can be underlined as one of the more internalized cognitive strategies of the repertoire. A mental representation of a specific city develops from many resources -- direct and indirect -- but a general city archetype combines people's experiences and knowledge of many cities, and creates a city template that people use when they find themselves in a new urban environment. For example, participants of this study developed a representation of New York City's street level before moving in. This representation integrated (1) their generalized notion of a city as configured by streets and avenues (blocks), areas (older areas vs. newer, residential vs. commercial, etc), and landmarks (salient buildings, for example); and (2) their previous indirect (from media or the subway map, for example) and direct knowledge of New York City (from prior visits). They had an existing spatial representation –sometimes

rudimentary and sometimes elaborated, even before they experienced the city directly.

Some post-Lynch studies underscore the importance of this generic knowledge when experiencing a new city (Devlin, 1976). My results confirm that people's quick understanding of the city structure suggest the use of this existing archetype of "City."

At the same time, my results support Kaplan's (1976) findings that spatial knowledge is a continuum ranging from the specific to the generic. In their first experiences in a new city, people employ their preliminary representation of the city to understand the new information, but eventually get to know the more detailed, specific characteristics that later are configured in their representation. In this sense, perception can be seen more as a cognitive decision-making process: fitting into categories, predicting probabilities, forming and testing hypotheses.

Research has shown (e.g., Downs and Stea, 1973; Siegel and White, 1975; Ferguson and Hegarty, 1994) that knowledge of a city includes two types of spatial information: route and spatial. New York City templates include both types of information. My study suggests that route knowledge is acquired and developed through direct experiences. Spatial knowledge involves a global representation of the city acquired directly and indirectly. Both types of knowledge get integrated into the generic map or template of the city.

Data from this study suggest that knowledge acquired through navigation is sequential in nature. It is internalized as part of a route first, and after repeated exposure, knowledge is integrated to the spatial map. Contrary to Moeser's (1988) results indicating that navigation does not lead to spatial knowledge, I suggest that after repeated exposure to routes people begin to incorporate knowledge into their spatial map of the city, and are able to integrate some environmental elements into their global representation of a specific city. My position agrees with that of Hart and Moore (1973), and Siegel and White (1975) who suggest spatial representation is developed as route knowledge becomes more detailed and enriched. As with Appleyard (1970), I found that in order to build a generic map or template, people struggle to fit their urban knowledge into a coherent pattern that matches their generic knowledge. Participants of my study addressed a strong preference, "*a need,*" to learn the city and organize this knowledge in meaningful ways (including but not limited to a mental map). Many decided to invest time and energy in exploring relevant areas during their first weeks of involvement in the study, going as far as taking notes and making plans to visit different zones. The data shows that people pick relevant environmental elements to place in their mental maps when navigating a route for the first time or experiencing a new area.

III. An action system in space

My findings suggest that people moving through cities (familiar or unfamiliar) may be seen as action systems in space configured by three connected and dynamic parts: mind, body, and environment. It is an "en-worlded," embodied mind (e.g., Clark, 1996, Varela, 1993). From the wide range of activities occurring in this mind-body-environment system, I focus on wayfinding and its development as a means of understanding the functioning of the system's dynamics. When a person relocates to a new city, he/she faces many changes. My focus is on the individual's spatial experience in the city in general, and particularly, on how he/she develops an understanding of spatial surroundings that enable her/him to get from one point in the environment to another.

In this study I use the case of newcomers as an example of action systems in space that move around the city. When walking around, the person continuously develops cognitive representations of the environment (e.g., a mental map), and most frequently navigates from one spatial point to another. This activity results in the sometimes purposeful and sometimes non-deliberate building of knowledge and understanding of the city.

Results of this study suggest that the physical activity of getting to a destination, navigating, and building a mental representation of space occur simultaneously (i.e., as an integrated system). As Thorndyke and Hayes-Roth

(1982) suggest, in the first stages of learning an environment, the execution of plans leads to the acquisition of environmental information. I suggest that plans and information acquisition are also retroactive. This means that through time, the developed map helps the person wayfind, which in exchange builds on or completes the pre-existing map. The developmental nature of wayfinding will be further discussed on Section IV.

IV. Wayfinding: The combined use of symbolic, environmental, and mediation strategies

The theoretical standpoint that frames this discussion comes from the integration of various elements of cognitive and environmental theories. In summary, mainstream cognitive theories focus on the symbolic aspects of spatial cognition, which they suggest occur inside the head (e.g., Vera and Simon, 1993; Piaget and Inhelder, 1956). The situated activity approach focuses on situated nature of behavior, not on the mental representations that afford it (e.g., Suchman, 1993; Cohen and Cohen, 1985).

Current studies of wayfinding (e.g., Hogan, 1975; Naveh-Benjamin, 1987; Passini, 1980; Garling et al., 1985) and cognitive mapping (e.g., Downs and Stea, 1973; Kitchin, 1994; Hart and Cohen, 1991), link these two tendencies by focusing on a behavior that requires both internal processing and the use of

immediate physical elements. The difference between my line of theorizing and the both Symbolic Processing and Situated Activity approaches is the conceptualization of wayfinding as consisting of a repertoire of strategies, including the ones studied traditionally in wayfinding (e.g., Passini, 1980) and those described by more cognitive approaches (e.g., Downs and Stea, 1973).

Some research in spatial cognition suggests that human spatial behavior is dependent on the individual's cognitive map of the spatial environment (e.g., Hart and Moore, 1973; Kitchin, 1994). According to this approach, given a cognitive map, an individual can formulate the basis for a strategy of environmental behavior (plan a route, for example). I suggest that such representation is one of many strategies used for wayfinding and is framed by the development of the cognitive repertoire. For example, a person will use a cognitive map only after the area or route has been learned and the internal representation of a map has been developed, that is, after the person has been repeatedly exposed to an environment. Obviously, a person cannot use a map that has not been developed and hence needs to rely on other strategies such as inference or the use of physical cues (a street sign, for example).

My view considers actions as part of the cognitive processes, and by doing so, eliminates the artificial division between the internal processes and the embodied actions as presented by Garling and colleagues (1985). These authors understand wayfinding as spatial problem solving and see spatial cognition in terms of

information processing, decision-making, and translation of decisions into actions, not as a fluctuation between internalized information and embodied actions.

Results of the current study support previous findings that suggest specific cognitive processes include internal manipulation of information, depending upon the saliency of environmental features (Golledge et al., 1985). These mental processes are intrinsically related to the actions that the individual makes during navigation, the knowledge (or cognitive) structures, and the processes related to decision-making.

This study builds on the findings of Golledge and colleagues (1985). They make an important theoretical move by developing a conceptual model that incorporates action and/or potential action as a critical component in deciding what environmental knowledge is accumulated and how it is used. I suggest that the representation is formed first because of the action that will be enabled by the symbolic structure developed. That is, action produces/encourages cognition, or in other words, cognition is action motivated, and is also the result of cognitive structures. In this way, cognition is iterative and self-propelling: cognition gained in action motivates and enables action, producing new cognition.

My findings coincide with Clark's (1997) notion of an embodied mind acting in space. I suggest that wayfinding is enabled through the use of strategies in the cognitive repertoire. These strategies are internal "mental" processes, embodied actions, and the use of environmental elements. There are no clear boundaries in the use and selection of these strategies. Their interaction and the weight they

have in wayfinding at any given point change according to specific factors, such as personal characteristics, familiarity, and the environmental context. In environmental psychology, these interactions are similar to Gibson's affordances. They are understood as the range of activities or behaviors that a specific environment "affords" to members of a species. I suggest that while spaces differ and hence allow different aspects of spatial activities to be observed (i.e., different spaces offer different affordances for navigating through them), there is an underlying unified spatial system-making activity.

Additionally, I suggest that wayfinding requires some basic sense of spatial integrity in form of a cognitive representation of the environment (i.e., a mental map), use of environmental context (such as a visible target), or both –when neither is complete enough to afford an adequate decision and/or action. These results support the findings of previous research (e.g., Giraudo and Pailhous, 1994; Moesser, 1988; and Thorndike, 1982; Schneider, 1995) that suggests people use resources like maps or directions instead of direct environmental information to acquire spatial information.

V. The spatial and temporal aspects of wayfinding: Wayfinding into waydoing.

The person-as-navigator may be seen as configured by three activity subsystems: a wayfinding system, a cruising system, and a way-doing system. When a route or segment of a route needs to be "figured out," the wayfinding system consists of the purposeful activity and decision-making involved with getting to a destination. The cruising system consists of an automatic behavior in which a certain degree of attention is still involved in navigation. The waydoing system is the less "conscious," less attentive part of spatial activity and can be seen as the body taking charge without much internal cognitive processing of environmental information. This usually happens when no decisions have to be made or no problems need to be solved.

Wayfinding, cruising, and waydoing require the complex integration of mental cognitive processes, environmental structures, and the activities that link them together, which have different weights at different times and parts of the route. These processes include: attention and decision-making; the use of the archetype of city; the use of spatial mental representations of other cities or urban environments; the immediate use of the environment at hand (signs, for example), and the "being there" of the embodied mind (crossing a street on a walk-light, for example).

These processes evolve and their interaction change (1) on different parts of a route (spatial factors), and (2) over time (temporal factors).

A. Spatial factors: Channeling

The spatial characteristics of Manhattan and the way they channel behavior and action have been thoroughly described in the Findings section. It has been suggested that channeling (as seen in Manhattans spatial organization and people's use of the environment) integrates with the wayfinding strategies (i.e., inference, use of city archetype, mental representations, and map making) to allow one person to get from one point of the city to another by foot.

Wayfinding literature has not yet addressed how spatial behavior varies along a route, and what different strategies are employed at different segments and why. I suggest that when walking a route for the first and subsequent times, a person will wayfind, cruise, or waydo at different segments or points of the route.

Environmental channeling defines in great measure the nature of actions and decisions involved in wayfinding. For example, I suggest that once people decide an action plan, they cruise until new decisions need to be made. New decisions and the related awareness will depend on changes of the environmental channeling.

Additionally, data show that as the complexity of an area increases, the more attentive processes related to wayfinding emerge. Moreover, when the

area or segment of a route is less complex, fewer attentive processes related to waydoing surface. This will be the pattern until the person learns the area through experience (See Section B. Temporal factors).

B. Temporal factors: A recursive model

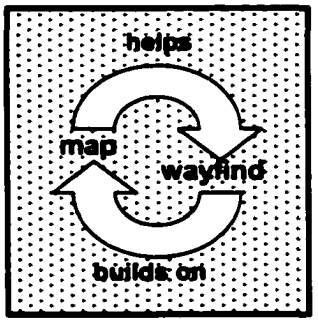
As described in the Findings section, my data shows that as knowledge of an area increases, the need to wayfind decreases and the getting from one place to another transforms into waydoing. For example, when a person is less familiar with an environment (e.g., moved to a new city), he or she will tend to rely more on a general city template (developed from experience in other cities) and/or on street signs to get to a destination. Data supports that as a person acquires more knowledge and becomes more familiar with an area and/or a route, he/she needs to make fewer decisions in order to get to the destination. At that time, he/she is simply waydoing the route. This means that wayfinding occurs only the first or first few times a person navigates a route, or in the case of complicated routes, before the individuals learns them.

As the person becomes more familiar with a route and an area, the weight of each factor in navigation shifts. He/she tends to use fewer internal cognitive processes (e.g., inference) as the specific mental representation already developed for that route is used, minimizing the use of environmental cues (such as signs or a relevant landmark). Ultimately, the whole experience becomes less symbolic,

internalized and attentive, and more embodied. That is, as familiarity and spatial knowledge grow, wayfinding decreases, and waydoing increases.

One way to conceptualize the spatial cognitive continuum is as a recursive and continuous interaction between internal information processing and situated actions.

Consider this model:



Whereas mapmaking is more of an internal activity that relies on external features, wayfinding is a situated activity that relies on internal processing. Some mapmaking occurs while wayfinding and, at the same time, maps developed earlier have an impact on the quality of wayfinding. By this recursive interaction, wayfinding eventually develops into waydoing.

This model suggests the integration of various elements of cognitive and environmental theories. My position agrees with the mainstream cognitive theories, in that some symbolic aspects of spatial cognition are processed internally. It also agrees with the spatial activity approach in that spatial activity, such as wayfinding, eventually develops into situated activity in which little

internal processing is needed, if at all. What needs to be underlined is the significance of activity in this process, as a cause and product of spatial cognition.

Whereas Cohen and Cohen (1985) focus on the role of activity for spatial cognition, I see it as a product and a cause of spatial cognition. They suggest that the structure of the environment also interacts with the individual's environmental experiences, but individuals in their theory are passive, only receiving information from the environment. They talk about activity as a reaction to the environment. This perspective differs from my view of activity as searching for environmental information, actively constructing the representation and linking the representation with the environment through its use.

Suchman (1987, 1993) succeeds in presenting activity as the centerpiece of spatial cognition but fails to integrate the relevance of internal processing in instances when the person must make sense out of new or complex environmental information. My study addresses such instances, specifically by presenting data of wayfinding from Washington Square to Angelika Film Center, where the environment does not support spatial behavior and other cognitive strategies need to be employed to achieve the goal.

On the other hand, Vera and Simon (1993) claim plans and other internal cognitive processes play the most important role before spatial behavior actually occurs. They fail to recognize that plans are not specifications or fixed sequences of actions, but instead are general strategies of actions. I suggest that behavior in space requires more than simply plans. Plans are only a preliminary step for

cruising and wayfinding, since while navigating in an unfamiliar environment, people remain alert to environmental cues even after having decided on a plan. By using environmental information, people are able to correct mistakes in their plans. Additionally, specific actions (such as crossing a street or picking a different route to a destination) are directly linked to the specific spatial context at any given moment (for example, crossing a street when on green-light).

Some intermediate perspectives, such as those presented by Greeno and Moore (1993), Clancey (1993), and Clark (1996) seem to work well with my own because they present internal processing as a specific case of cognitive activity while denying that this type of processing is the centerpiece of spatial behavior. Both symbolic and action structures are created during activity, always arising together within the overall system of brain, body, and local environment. These constitute a proper, continuous, and unified object of study that presents reciprocally transforming influences between its elements.

With this dissertation I have taken steps to develop a theoretical framework that integrates elements of mainstream cognitive theories and ecological, environmental approaches to the study of spatial cognition in general, and wayfinding and navigation in particular. These concerns are not only of basic theoretical importance but also have application and bearing in the context of globalization, since people are moving from one city to another more than ever before.

I hope this work will contribute to the design of more "newcomer-conscious" urban environments by informing urban planners about ways of making environments accessible to non-local and local people. For example, by providing route maps at strategic points with representation of landmarks, or signs in different languages. This is especially important in today's world in which migration and extended travel are the rule rather than the exception.

The objectives of this type of work are to improve the quality of life and the experience of people adapting to new environments as well as to help build more intelligible cities.

At a theoretical level, this study supports the notion that cognition of space involves symbolic processes, situated actions, and some degree of information mediators/tools such as maps. The weight of each in spatial behavior at any given moment will depend on multiple elements, such as familiarity, specific environmental characteristics, and wayfinding style, among others.

These elements will change over time and therefore should be studied developmentally, as suggested in the current study. Developmental research in spatial cognition has been performed in the area of cognitive maps, but research prior to this study had not yet focused on the changes in purposeful behavior and wayfinding over time. My theoretical claim calls for the integration of methodologies that will encourage the study of internal processes and situated actions simultaneously and developmentally, such as the ones employed in this study.

VI. Implications for future study

Additional research is required to further understand the mind-body-environment action system. Considering the current theoretical and methodological foundation, the following topics of research emerge. There are two overarching issues to be explored. First, are there additional strategies at work in wayfinding, and how can they be characterized? Second, how, why, and when are these various strategies employed by the action system? Simply stated, what more can we learn about how the mind, body, environment system works?

These larger questions can be further elucidated by qualitative and quantitative studies designed to explore the five following questions:

1) How are heterogeneous groups both similar and different in the employment of these symbolic, environmental, and mediational strategies? Research exploring the impact of variables such as socio-demographics (e.g., gender, age), socio-economic level, literacy level, and English-proficiency, would help identify patterns in the usage of symbolic and action strategies related to wayfinding. This knowledge could be translated into plans to make areas (and ideally whole cities) more legible and accessible to specific and/or general populations.

2) How are individuals both similar and different in the employment of these wayfinding strategies?

Individual differences and characterization would bring light to the detail to which these strategies differ structurally and in the way they relate to one another. Thorough the contrasting of individual cases, patterns would be identified to enrich the more global data obtained from larger samples.

3) Across both groups and individuals, how does the usage of strategies change and/or remain consistent across shorter and longer expanses of time than investigated in this study? In short, what more can be learned about the development of the mind-body-environment action system?

This question implies two approaches. One should focus on immediate changes in the usage of strategies (i.e., from one day to the next or from one navigation of a route to the next). The other should concentrate on changes in the usage of strategies over extended periods of time. These studies would identify different detailed patterns in the way symbolic and action strategies collide.

4) Across both groups and individuals, how does the usage of strategies change and/or remain consistent across simpler or more complex environments?

Focusing on patterns of action on types of environments (i.e., complex or simple) would help understand the integrative aspect and of the mind-body-environment system and define the value of each wayfinding strategy in different spatial contexts.

5) To what extent are individuals aware of their usage of representational and action strategies in wayfinding? Through direct questioning, can

individuals themselves shed light on when, why, and how they employ these strategies?

After I analyzed the data, I thought it would be extremely interesting to have people reflect on the strategies they employed while navigating a route. Most probably, people have a lot of information to share on what they did while navigating, why they chose to do it, and what changes they experience over time.

Two additional areas of research would extrapolate this study to different settings. First, the study of wayfinding larger distances within the city navigated by automobile or other means of transportation (e.g., from Lower Manhattan to Jamaica, Queens). Driving and the processes involved in this type of wayfinding probably involve similar structures and strategies than to the ones described here, but the scale and the distance-time ratio change dramatically from walking to driving. The study of these differences would shed additional light to the understanding of cognition of and action on urban environments. Second, cross-cultural studies (e.g., Americans' wayfinding in an American city versus Europeans' wayfinding in a European city) would take the research questions to the next level by comparing different groups of action systems (different combinations of minds, bodies, and environments).

This research provides a theoretical and methodological foundation for these inquiries.

APPENDIX 1

Description of participants

The following descriptions of participants' wayfinding style are based on their own description of their wayfinding ability and style. I have also integrated my own observations/notes about their style.

Judy "Accuracy is best"

Judy is in her mid-twenties. She went to college in a small city in Ohio where she lived for four years prior to moving to New York in August 2000. Throughout the duration of the study, Judy lived in South Hall, CUNY's housing for graduate students located on 18th Street between First and Second Avenues. Before moving to New York, she visited the city in November 1994 for one week and in January 1996 for a few days.

Judy prefers to plan an efficient route prior to wayfinding in the city. Once the route has been tested, she prefers to repeat it rather than try different routes each time. She frequently breaks a long route into smaller segments that are easier to remember and manipulate when wayfinding and learning a new area. She enjoys when her planned route turns out to be the most efficient one and enjoys testing the different alternatives by trial and error. That is, the first time she wayfinds a route, she usually gets just enough information from indirect resources (such as maps) to have a

"general picture" of the zone and route. After gathering information, she actively seeks environmental cues to support her plan as she walks.

Mary "Comfortable exploration without compromising a sense of safety"

Mary is in her late-twenties. She lived all her life in San Jose, Puerto Rico prior to moving to New York. Through the duration of the study, Mary lived in South Hall. Before moving to New York, she visited the city once in April 2000 for a few days.

Mary enjoys walking in the city and maintains a comfortable pace while wayfinding. She does not purposefully or consciously plan routes but rather starts walking towards the general area of her destination and figures out the route as she goes, usually using environmental information at hand such as street signs or openings in the streets with threes as indicators of a square. She chooses different routes at different times depending on her mood, the time of the day (to feel more secure), and other variables such as time or weather constraints.

Clarisa "Shops and restaurants are main landmarks"

Clarisa is in her late-twenties. Before moving to New York in August 2000, she lived in Silicon Valley for four years. She resided in South Hall throughout the duration of this study. Clarisa had previous experiences in New York. She visited New York in 1996 for one week, in 1999 for a weekend, and in Spring 2000 for two days.

Clarisa likes to "know and understand where [she] is." To get to know a new city, she spends a considerable amount of time walking around during the first few weeks, checking local maps and exploring. Once she identifies convenient routes and areas where she feels comfortable, she sticks to them and spends her energy focusing on other thoughts. Exploration only lasts a few weeks in which she organizes the city and routes mostly around the shops and restaurants she likes.

Rob "Balance between efficiency and exploration"

Rob is in his early-twenties. He went to college in El Paso, Texas, where he lived for four years prior to moving to New York in August 2000. Throughout the duration of the study, he lived in South Hall. He had never been in the city prior to the study.

Rob has a relaxed style of navigation and wayfinding; he walks at a comfortable pace. He shows a compromise between efficiency and exploration, although he ultimately prefers to be efficient. His strategy of getting to know the city is to walk different paths and then identify the most suitable to him according to efficiency and a more subjective preference of "liking the route."

Jack "The big explorer"

Jack is in his late-twenties. Prior to moving to New York, he lived in Las Vegas for 3 years. He was in New York twice as a kid and once when he was

eighteen years old. Throughout the duration of the study, Jack lived in Williamsburg, Brooklyn.

As big explorer, Jack compromises efficiency for exploration and is hardly hurried. He keeps pace with the speed of the crowd, giving himself plenty of time to get to his destination. He prefers to take new routes as often as possible, especially in areas that he likes. He organizes the city as layers and spatial pockets that become more detailed and wider through experience/time.

Dean "The street-sign guy"

Dean is in his early-thirties. Prior to moving to New York, he lived in Athens, Greece. Throughout the duration of the study, Dean lived in South Hall. Before moving to New York he visited the city once in 1998 as part of a guided tour.

Dean does not have an interest in exploring the city or looking around as he walks. For him, the city consists of places that have a function in his life, such as his dormitory, the Graduate Center, City College, and the links between them. When navigating, he looks at the floor and the street level as he walks rather than at buildings or people. He does not actively try to build a representation of how the city is organized, but rather thinks of non-wayfinding topics as he walks. Rather than representing locations, he remembers details about them, such as the circles drawn on the floor at the north side of Union Square or a detail of a church on Fifth Avenue. He relies on maps to wayfind, and usually gets easily frustrated when finding a destination in an unfamiliar zone.

APPENDIX 2

INTERVIEW GUIDELINE

Introduction

As you know, we are going to do some walking and talking today. There are some general areas that I want to discuss with you, but basically this interview will develop as a conversation as we walk, more than a question-and-answer format.

Remember that I am in no way evaluating you or your performance, and that I am interested in everything relevant to you, the city, and how you move through it. So tell me everything you think, even if you don't consider it relevant. OK?

PHASE I: Awareness

A. General spatial habits

- Please think of a route that you traveled by foot frequently in the last year in your city or town, a place to which you often traveled. Could you describe how to get from place A (say, your house/dorm) to place B (friend's house/classroom) of this route?
- Give me detailed directions... Focusing on a segment of that familiar route, please tell me everything you see, do, and pay attention to as you navigate.
- Can you identify strategies and/or patterns you had for getting to your destination?

Probe:

- Did you go always go the same way? Why did you change your route? Tell me about it...
- What things did you pay attention to? Did you pay less attention to some things after a while? Tell me more about that...
- What factors affected your route decisions?

Probe:

- Time of day? Weather? Means of transportation?

B. New environments

Now lets talk about the experience of getting to a destination for the first time.

- Please tell me about a time when you went to a new building or a friend's house for the first time.
  - How was the experience? How did you get there?
  - Where you comfortable/uncomfortable? Why?
- Is it usually hard for you to get to new places? Easy? How is it hard or easy?
- Do you think it is easier or more difficult for you than for other people to find your way in a new environment? Why is that?

Probe:

- Do you plan a route or strategy ahead of time, or do you begin your trip and then think about the route? Or do you figure it out as you go?
- What helps you figure it out "as you go?"
- What type of things do you pay attention to?
- When do you pay attention to these things?
- When or in which cases don't you need to pay attention? Why?

Now let us talk about finding your way in a new city. We will get to talk about this more in depth later in the interview, but I would like to address some issues now.

- When you first move to a city, how do you get to know the environment? Do you organize this new spatial information? If yes, how?
- How do you usually manage to get to a destination in a new city (for example, when you go on vacation to a new city)?
- What things help you to orient yourself in space? What strategies do you use to orient yourself in a new city?
  - Which elements of the city's environment are useful? How?
  - Are there any other elements, say more internal or less "physical/spatial" that you use when moving through an environment? Tell me about those...
- How is it different when you move through a familiar environment or route as opposed to a new environment, or walking a route for the first time? What else is different?

C. Existing knowledge of New York City

(Introduce topic at the end of sitting down stage, but revisit during walk-along, whenever relevant)

Let's talk a little bit about what you know of New York City so far.

- What you know in terms of its spatial organization or configuration?
- How you move around? Do you prefer to walk or use public transportation?

Probe:

- Were you in the city before you moved here to attend graduate school?

If yes,

- When? For what purpose?
- What did you learn about the city?
- What things in the environment were important or significant to you? What elements do you remember the most?

- Did you learn anything about the city's spatial organization? What?
- How were these things useful to you as you moved to the city to attend school? If no,
- What did you know about New York City's environmental features and spatial organization before moving in? Where did you learn this? When?

Since you have been in New York for a few weeks, you already have some experience in the city.

- Could you please tell me what have you learned in these weeks in terms of your environment?

Try thinking and telling me what has changed of what you know about the city since you first came.

- What do you know now that you did not know before you came?
- Why do you think you know that now? Why was that important to learn?
- Tell me about that process.

PHASE II: Wayfinding

D. Actions in New York

Now we are going to go from the Graduate Center to Barnes & Noble at Union Square. Please tell me everything that comes to your mind in terms of what you do to get there, what decisions you are make, and why. It is like thinking out loud. Everything that you say will help me understand what is happening as you wayfind. Please do not hesitate in telling me about every detail of your navigational experience.

As walking and when relevant, ask:

- What elements are you paying attention to in the environment? Why? In which ways are they helpful in finding your way?
- How is that element (sign, shop, building, etc.) helping or not helping you to get useful information? What type of information is it providing?
- How does this experience of moving through the city compare to other occasions in which you moved through a new space, as you described before?
- How is this experience the same or different from moving through a known or familiar space? Tell me more about that...
- Do you think you have made mistakes? What type of mistakes?
- How do these mistakes affect your actions? What did you do to fix your mistakes? Please tell me more about it...
- Do you usually make mistakes in contexts like this one, when you are finding your way in a new environment? What are these mistakes? How do you feel as you make a mistake when finding your way?

Probe:

- Do you feel uncomfortable? If yes, in which ways?
- Do you feel anxious? Why/why not?
- Have you ever felt anxious in a situation where you were disoriented? Tell me about it...

E. Specific environmental elements and orientation

When relevant, ask:

- Is there anything that catches your attention in the streets? Anything you think you will remember? Why?
- If you were to go south, north, east, or west, how would you know which way to go? What else tells you north is that way? Would you be sure?

- Is it useful for you to know which way is north when you are moving around and/or trying to get somewhere? How is it useful? For example, would you know which way is north in a new environment? Now?
- What other things are useful when trying to find your way in a new environment?
- Which of these elements do you constantly use when you find your way in new environments? For example, do you always [fill with participant's speech i.e. *read street signs*]
- Do you think there are people that are "good with space?" Do you think you are? What does it mean to you "to be good with space?" What characterizes it? What skills does a person have to possess in order to be "good with space?"

We are getting to the end of our excursion and before we get to a stop, I would like you to think if there is anything else you would like to tell me about your experience today.

- Anything you think in terms of your actions while moving in the city?
- Anything about the city itself as it helps you or deters you from getting to your destination efficiently?
- Anything about how you think you could become more efficient when navigating this route or in this area?

PHASE III: Map/Sketch drawing

Now that we are comfortably sitting down, I want you to draw a map or a sketch of the area or the route that we walked today. Please try to include as many elements as you possibly remember, especially those elements that you think will be helpful to identify the area or a route in the future.

At the same time, as you're drawing please tell me what you're doing. Again, it's like thinking out-loud and describing the actions you were doing and how these actions depended on certain physical/spatial elements. Describe what you're

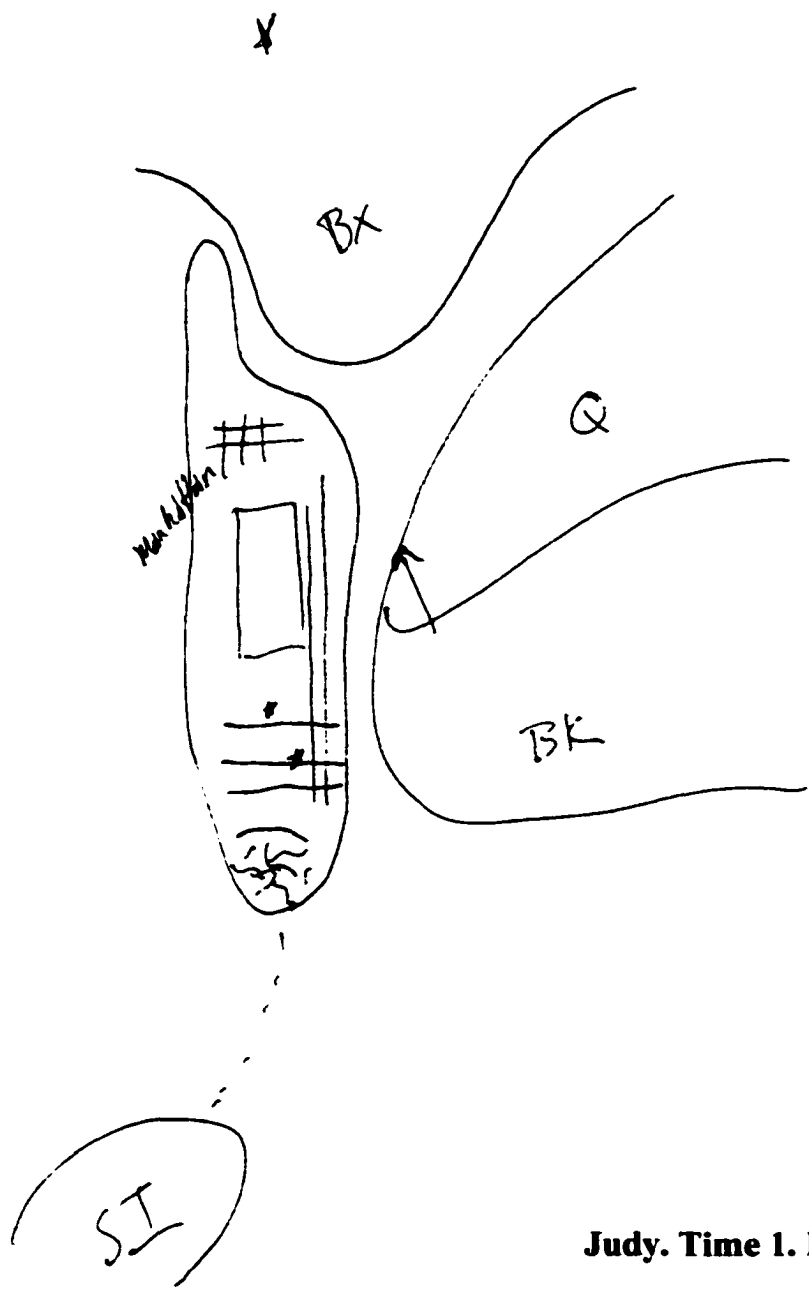
drawing and what you're thinking as you remember. Why do you think you remember that specific thing or action?

Prompt:

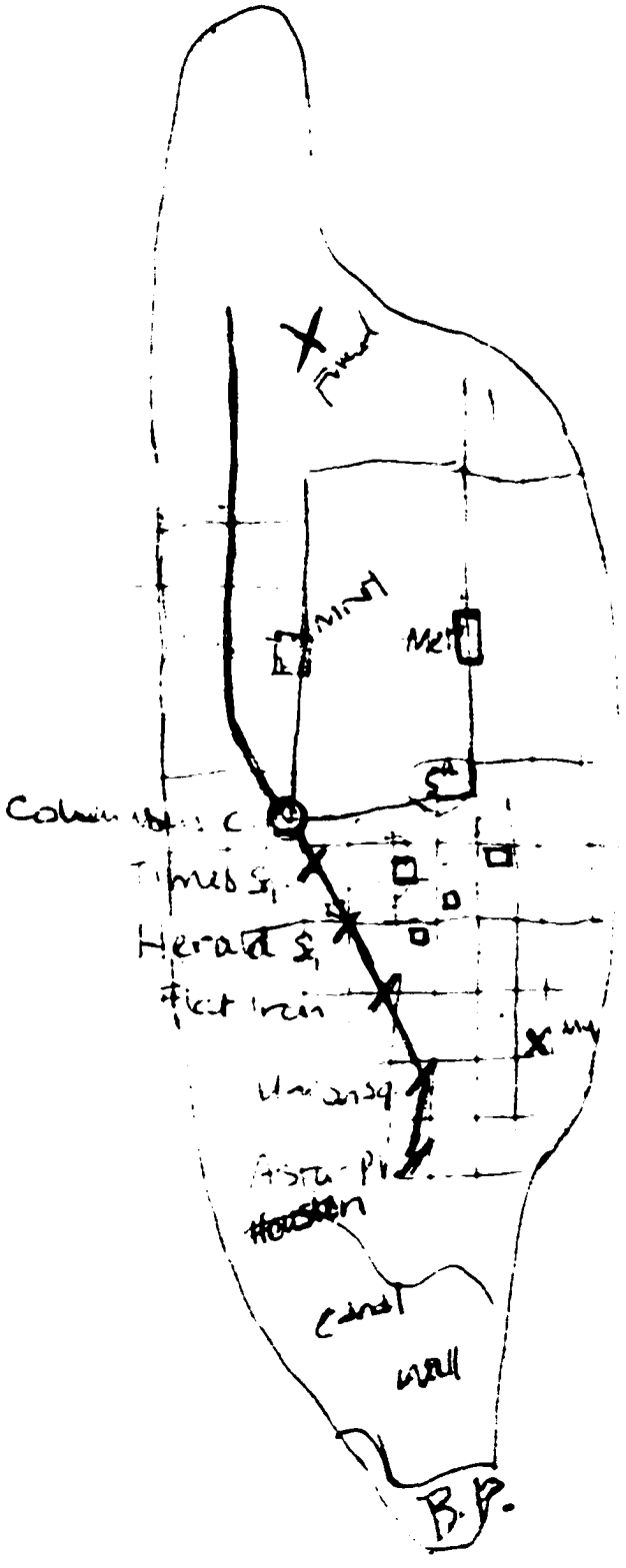
- How was this important? Why do you think you remember it?
- Do you think you'll remember it in future visits?
- How will it be helpful?
- How did it help or deter your actions?
- Do you remember where it was located in reference to other things?
- Do you think you made mistakes or included inaccurate information?
- Do you think that will change with time? In which ways?

Thank you very much.

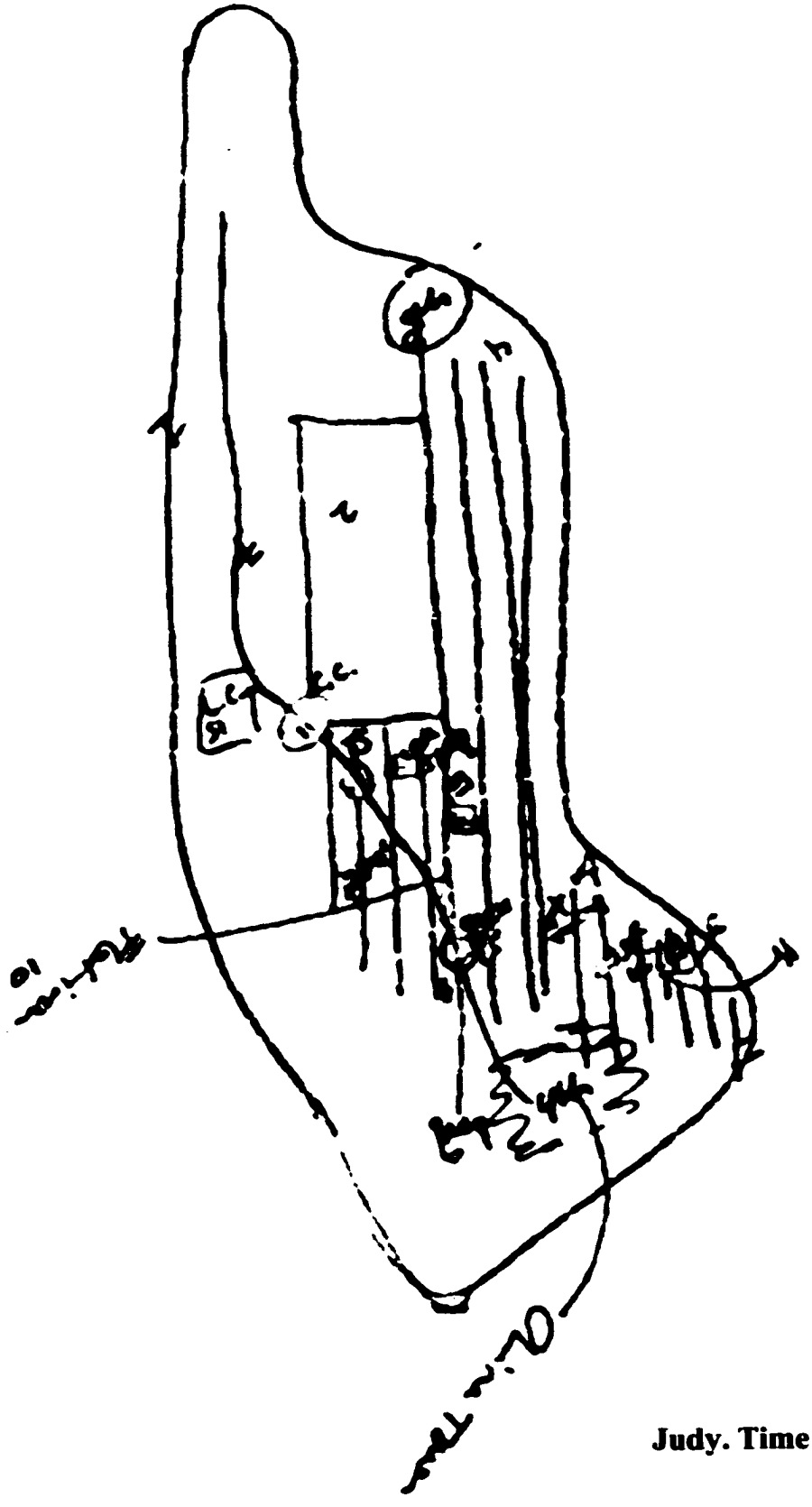
APPENDIX 3. Maps by participants



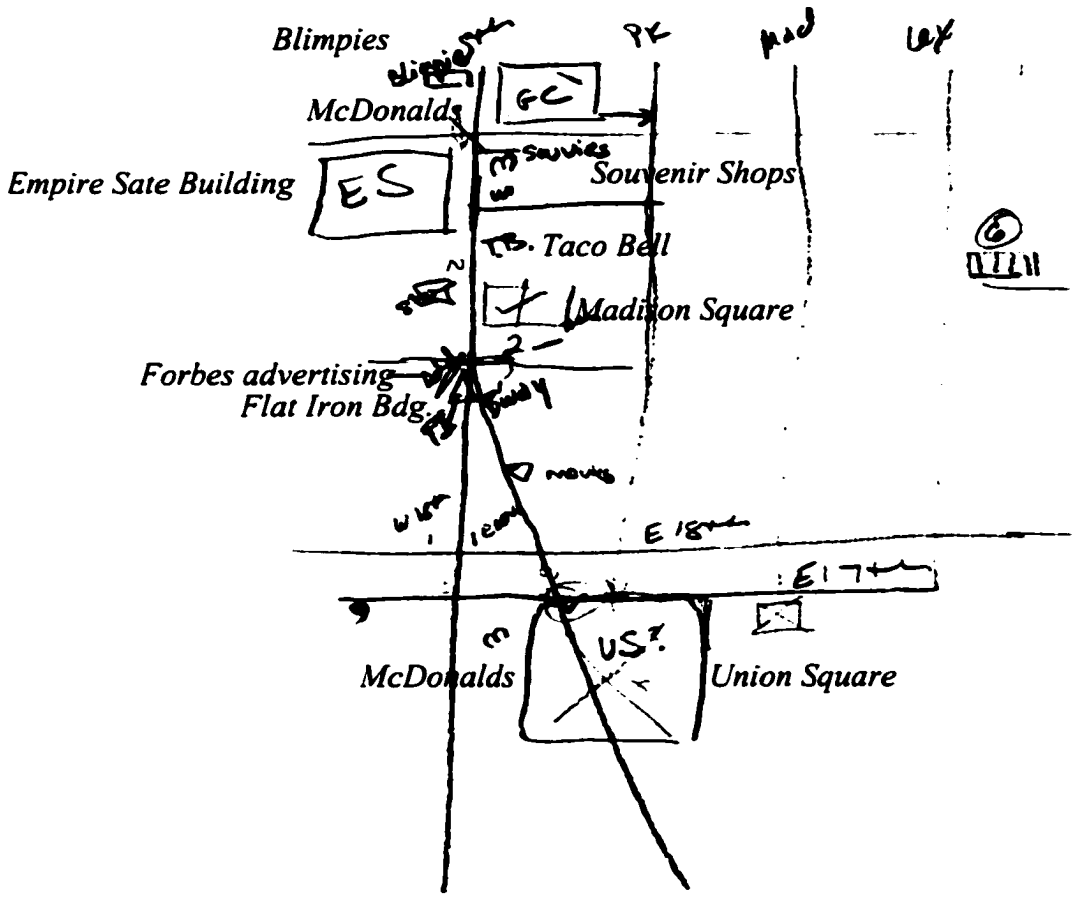
Judy. Time 1. Manhattan



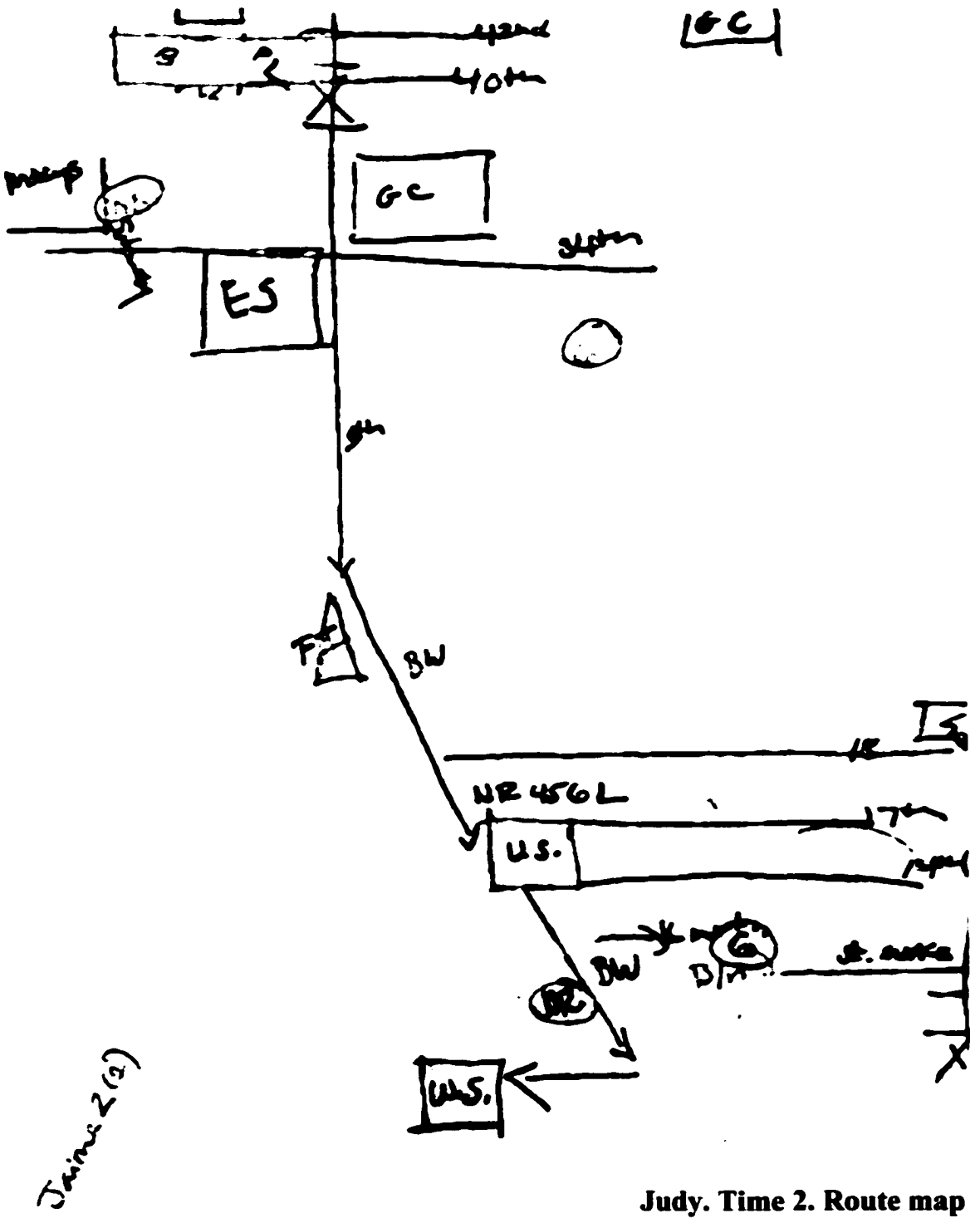
Judy. Time 2. Manhattan



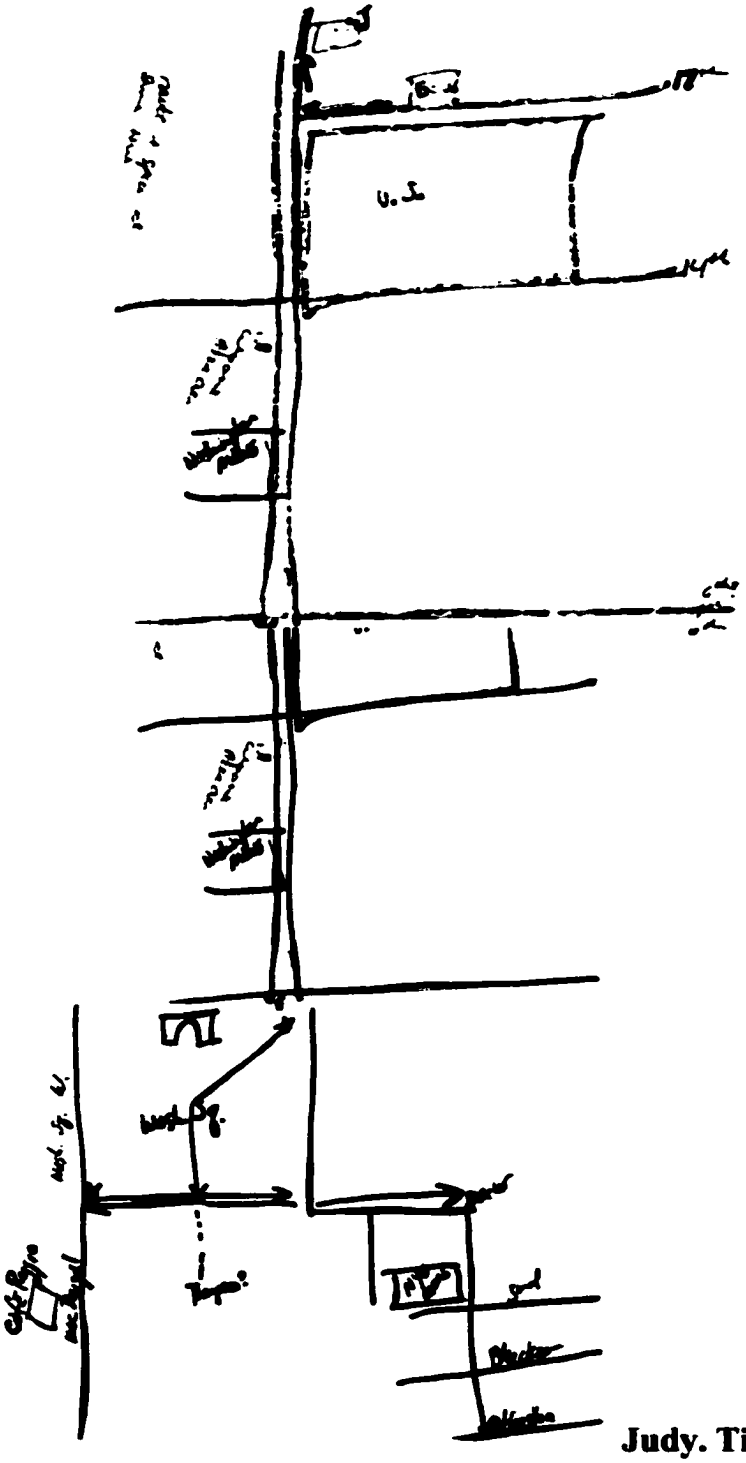
Judy. Time 3. Manhattan



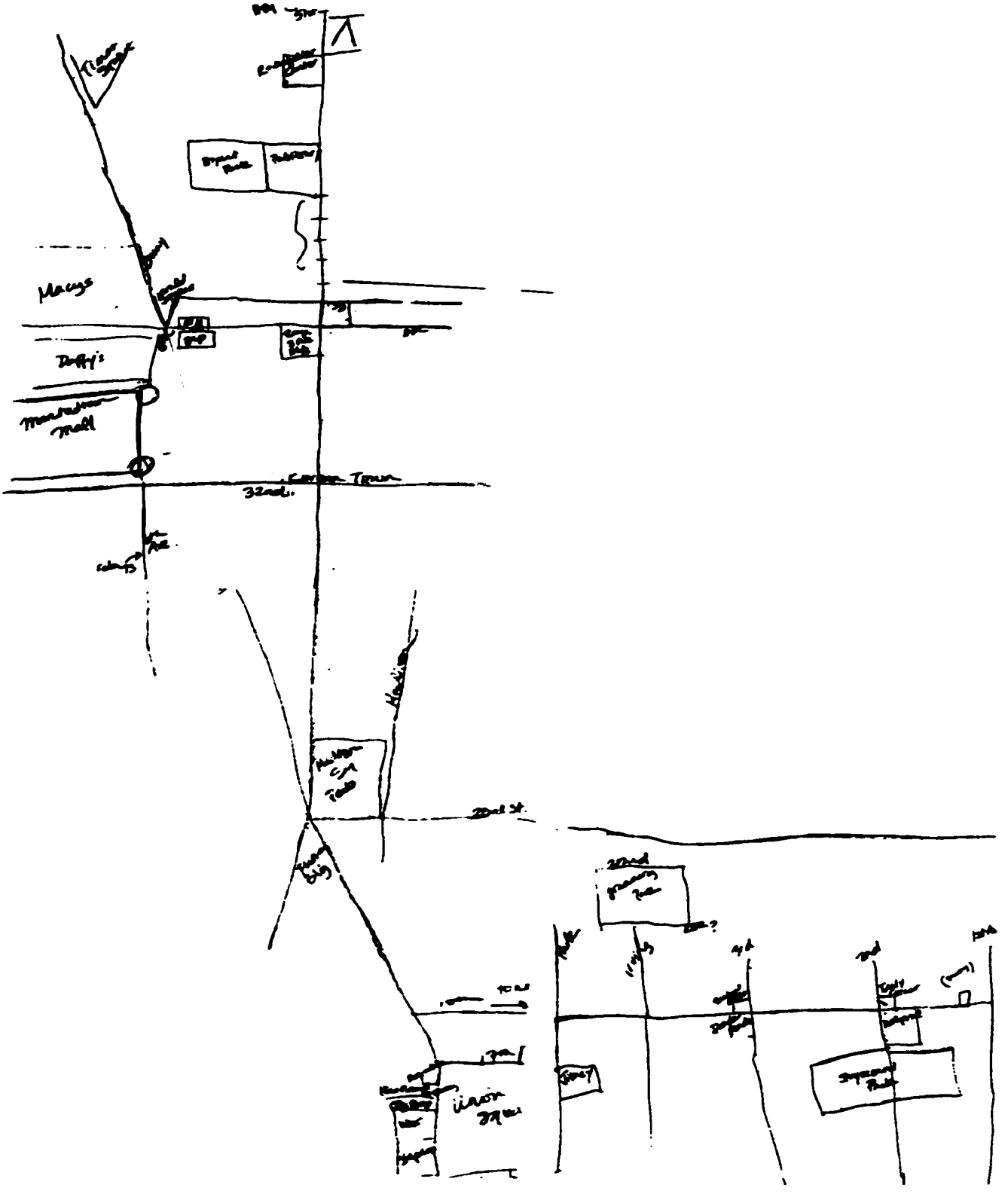
Judy. Time 1. Route map



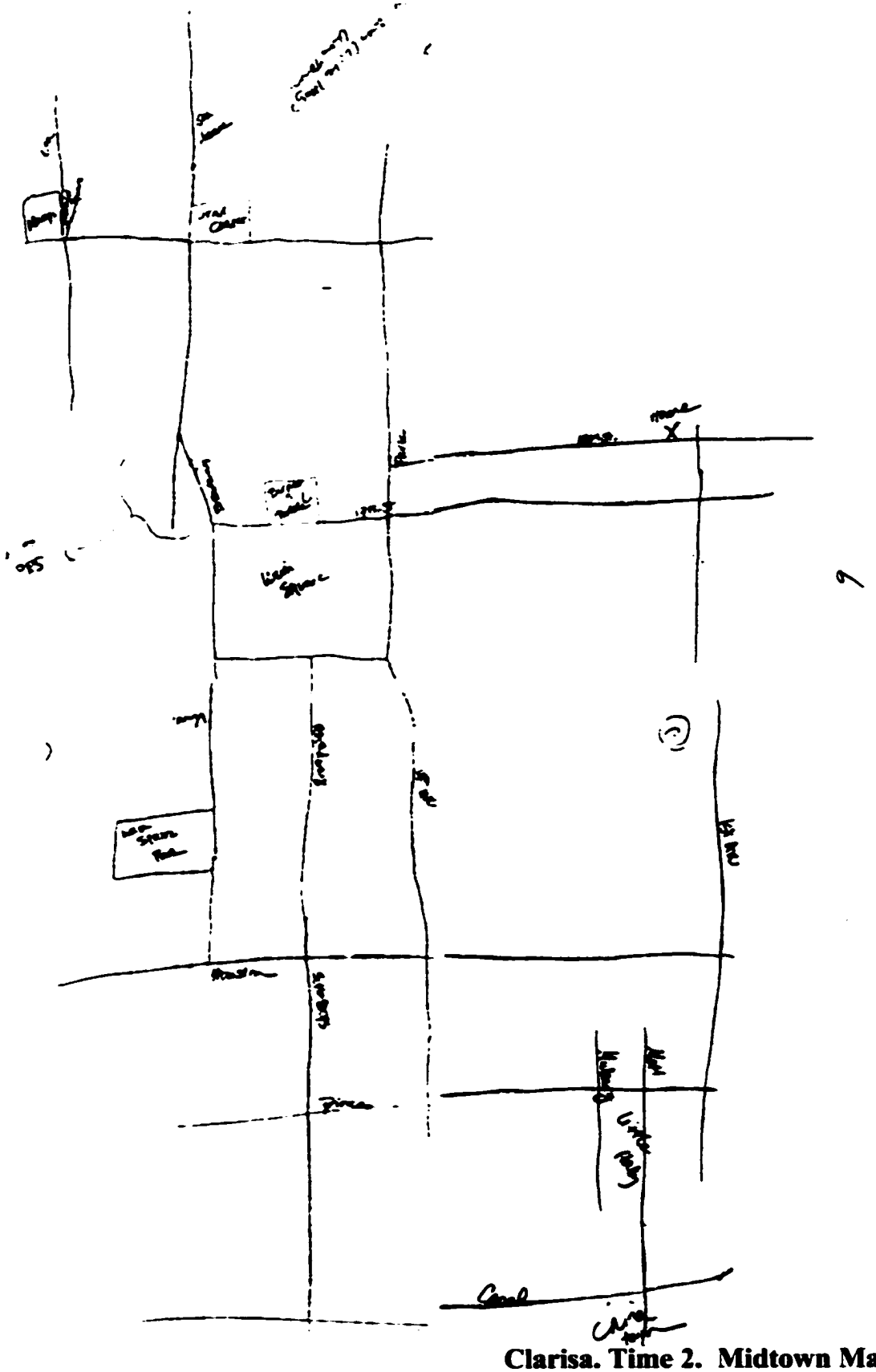
Judy. Time 2. Route map



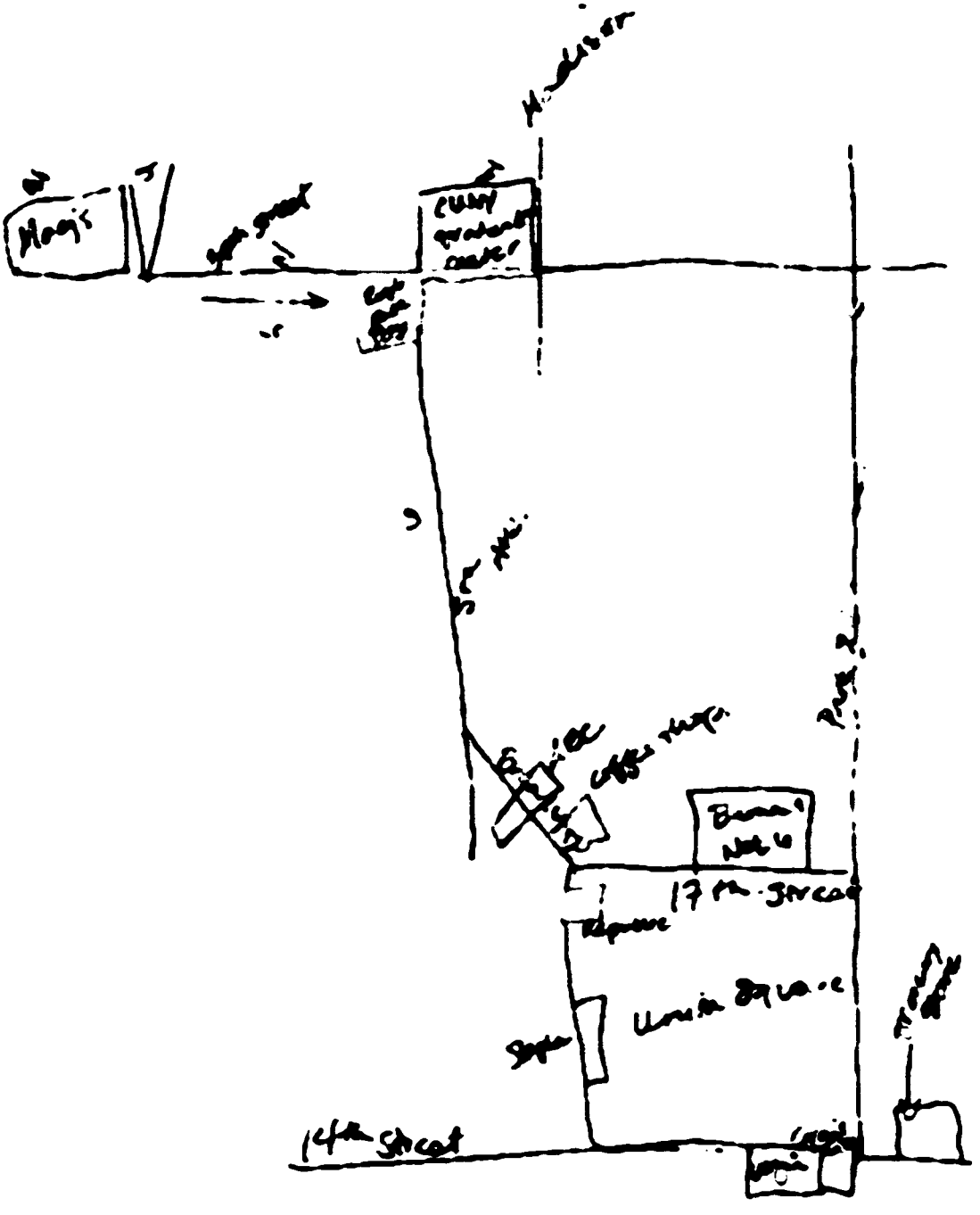
Judy. Time 3. Route map



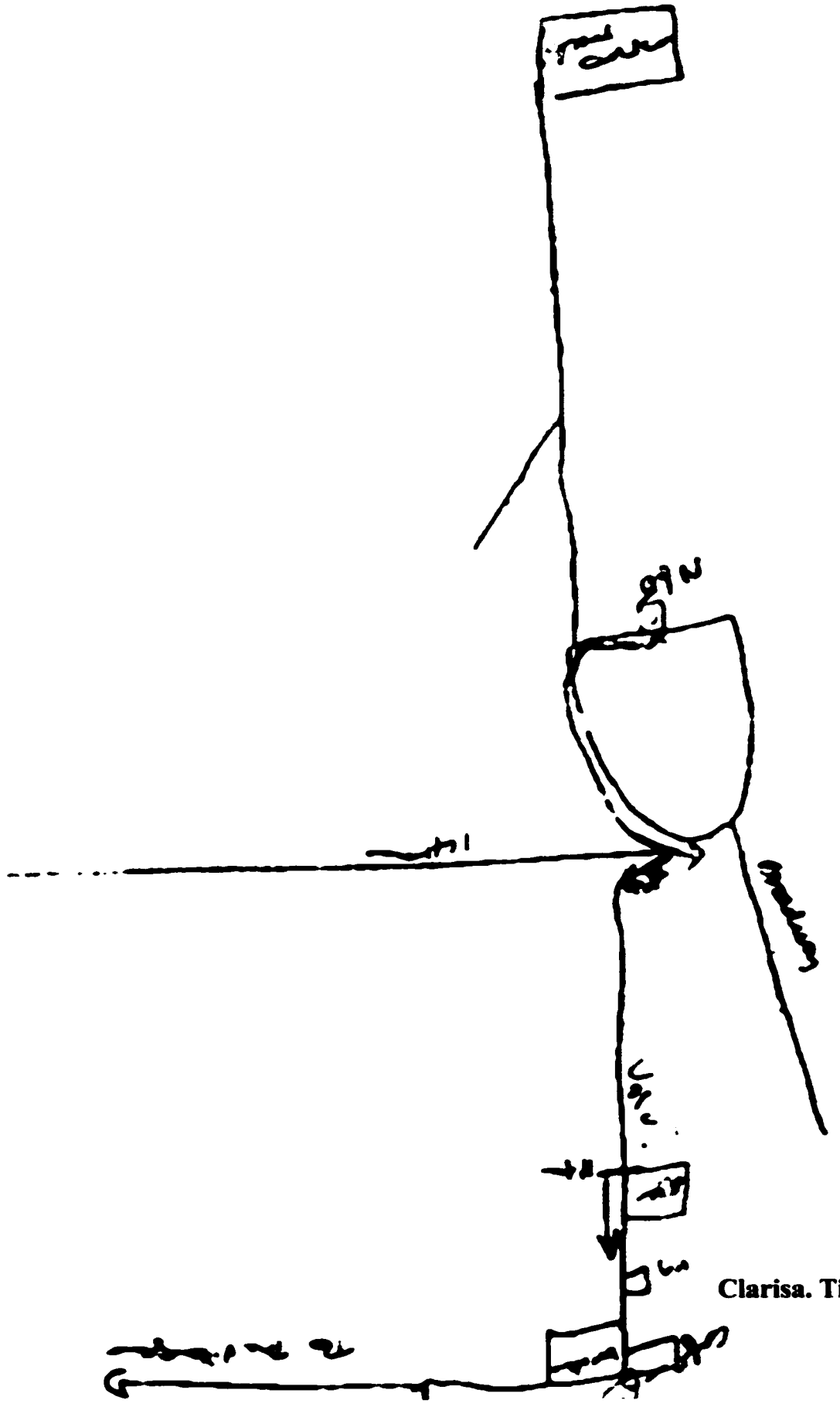
Clarisa. Time 1. Midtown Manhattan



Clarisa. Time 2. Midtown Manhattan



Clarisa. Time 1. Route map



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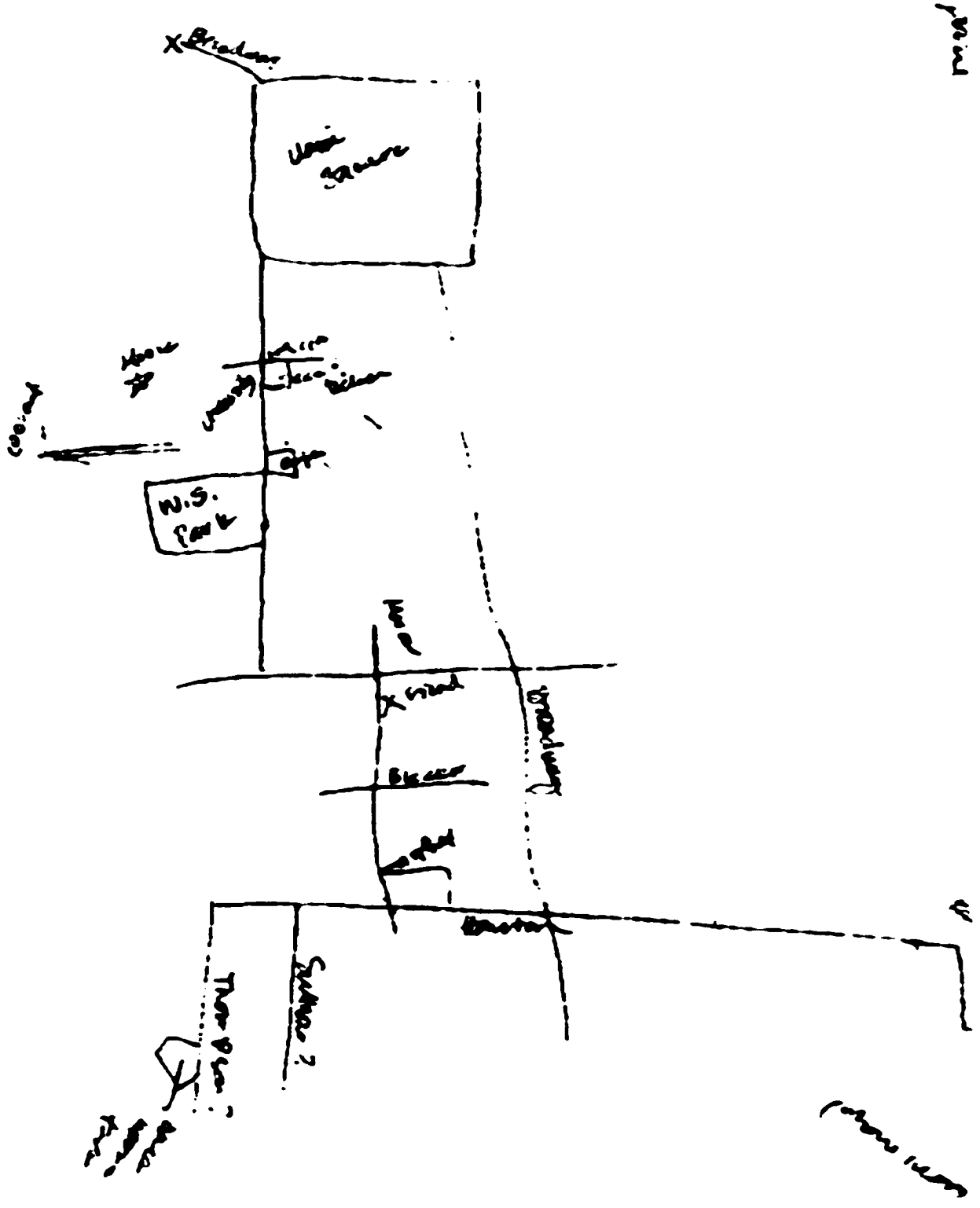
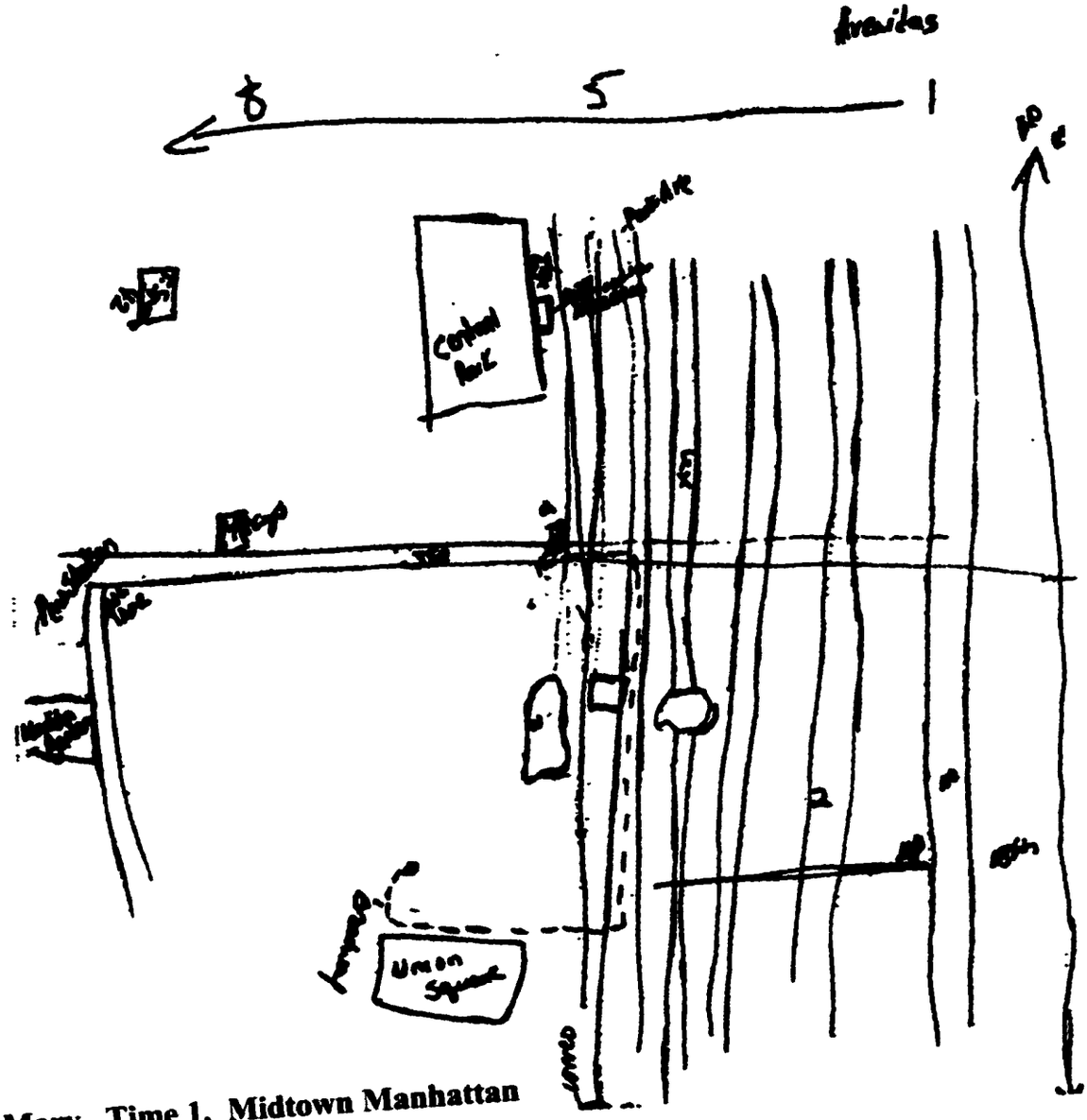
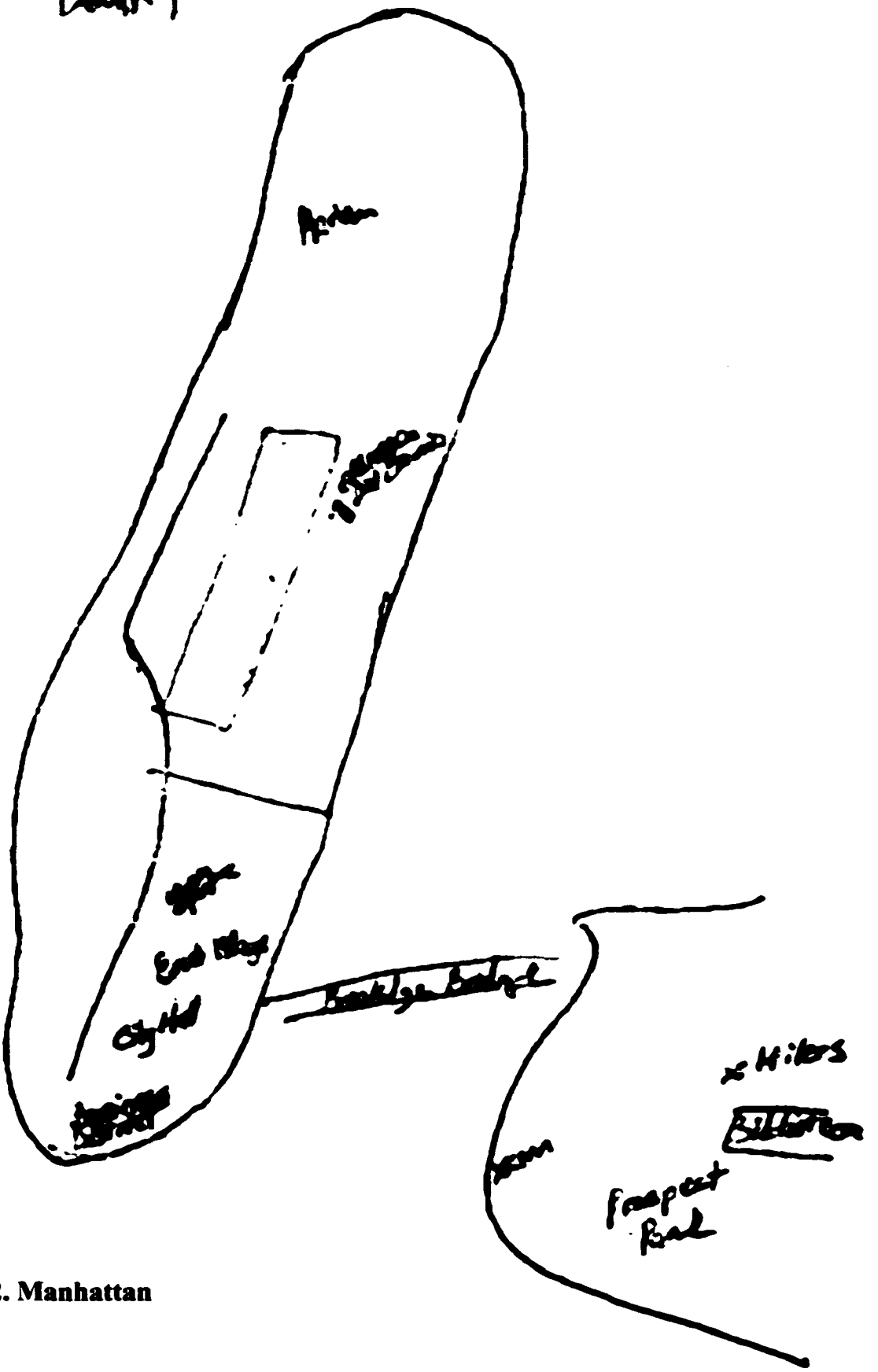


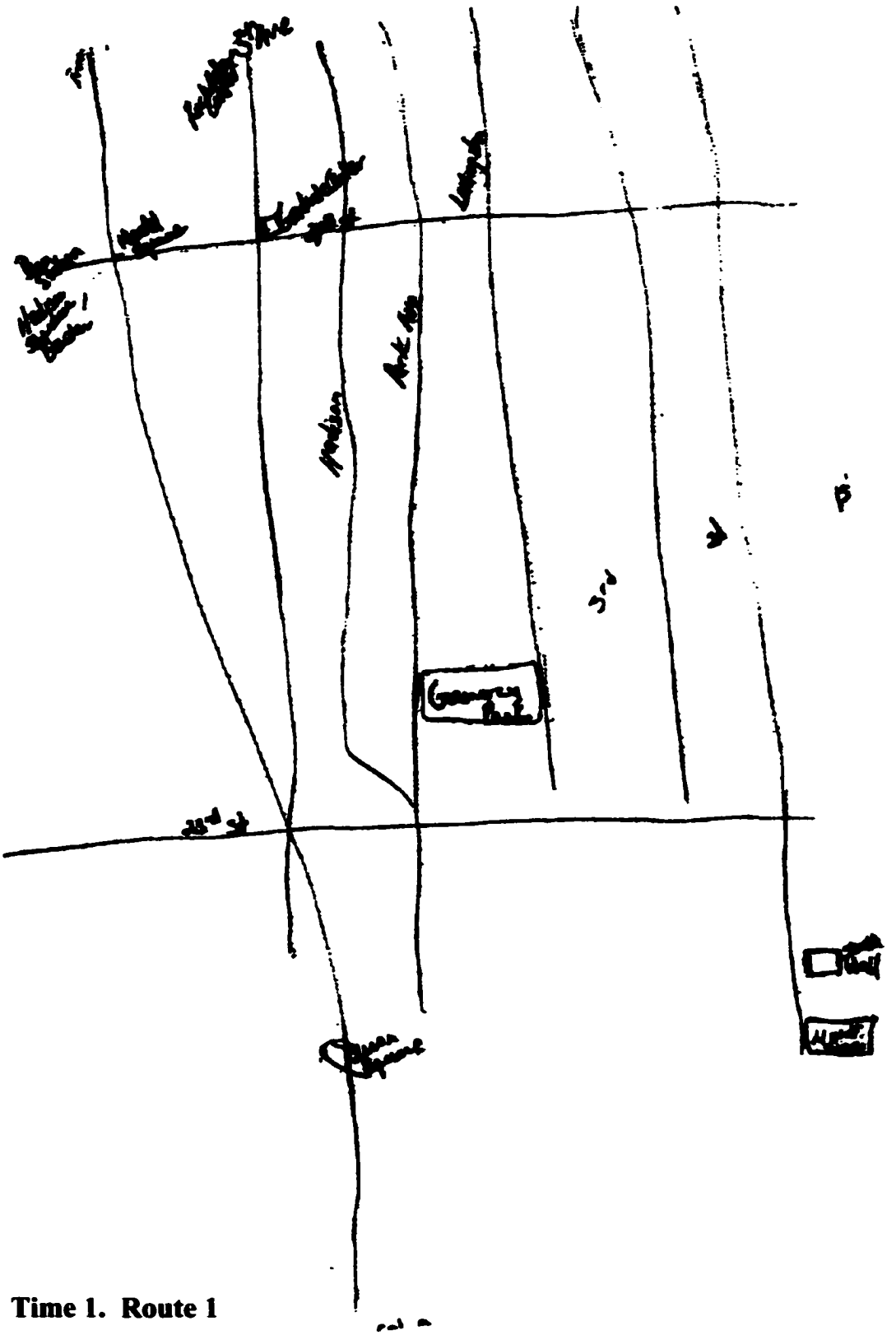
Clarisa. Time 3. Route map



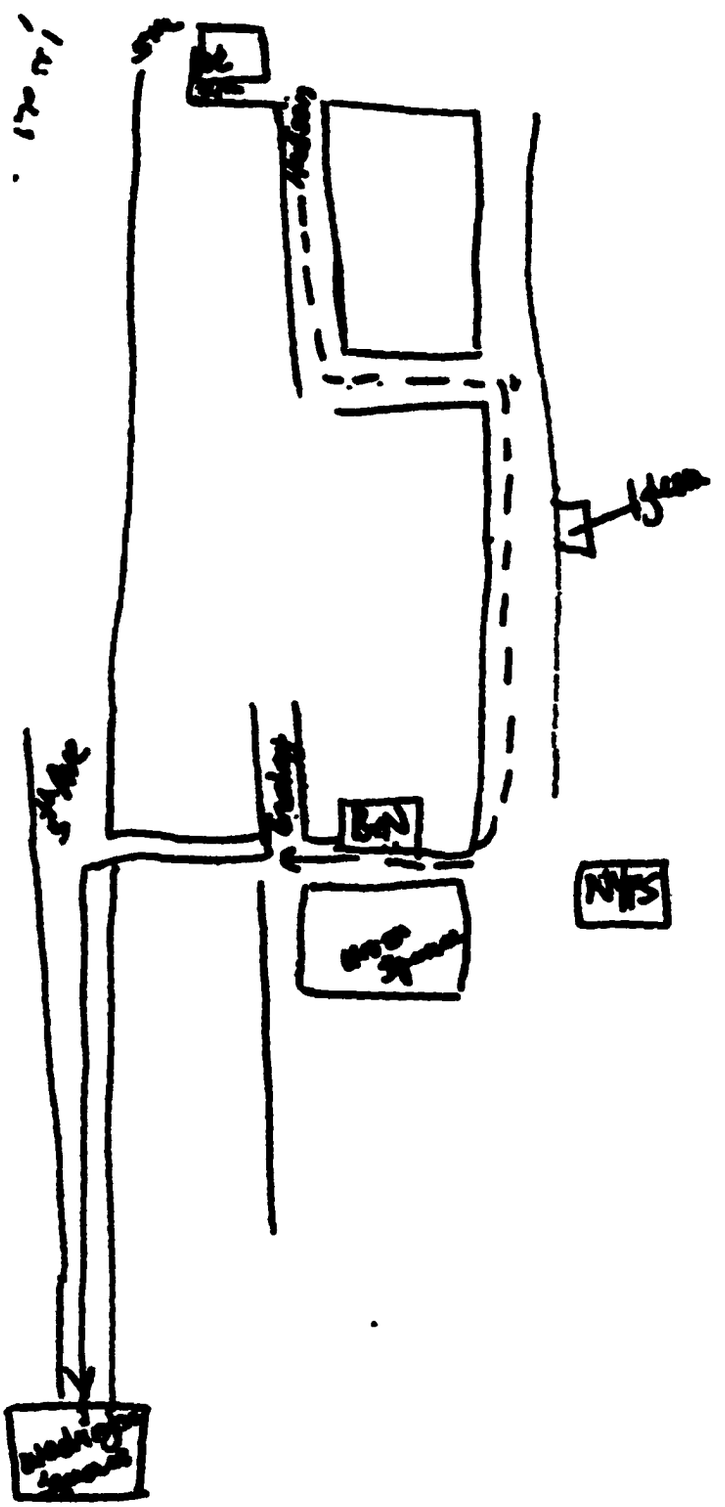
Mary. Time 1. Midtown Manhattan



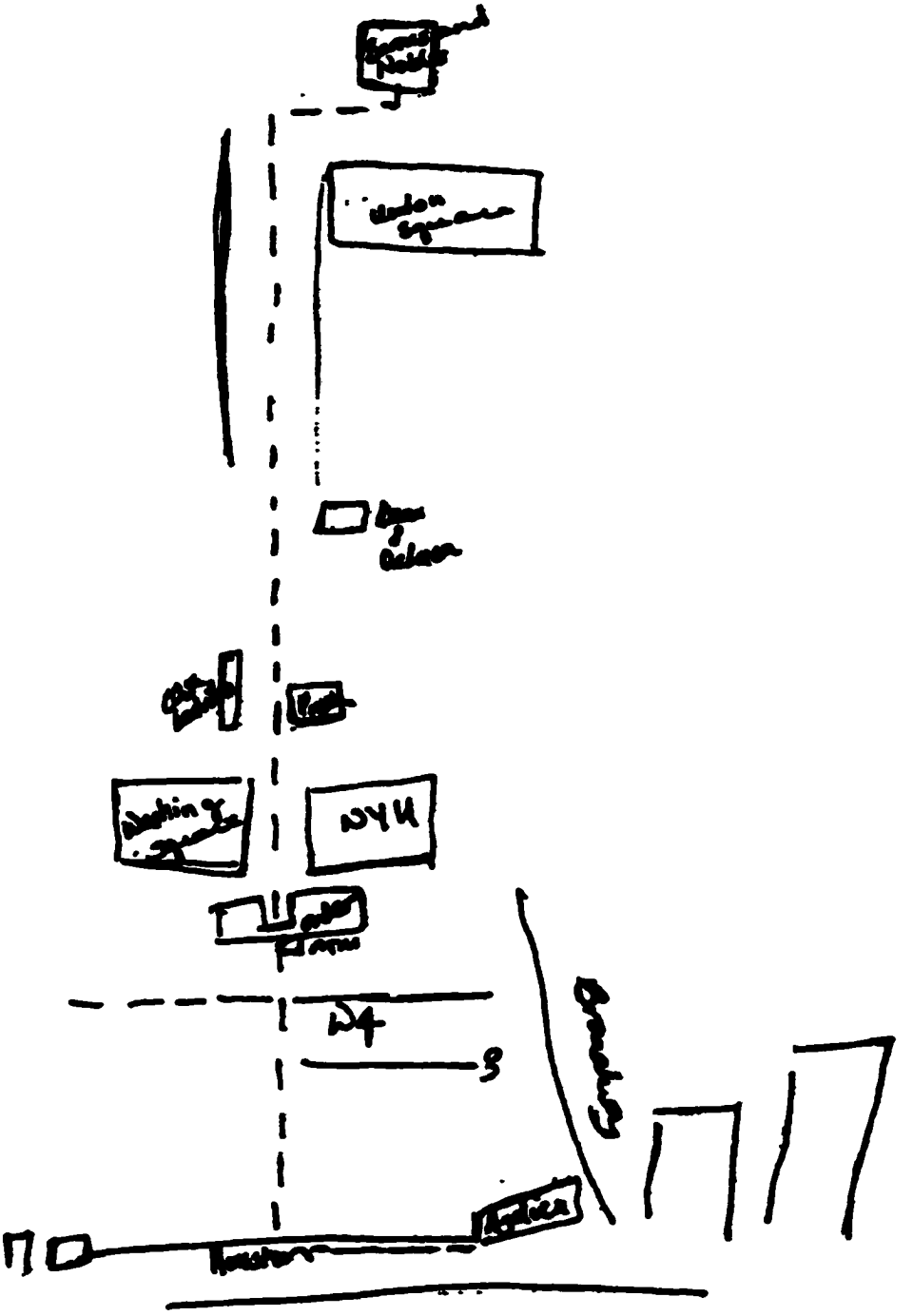
Mary. Time 2. Manhattan



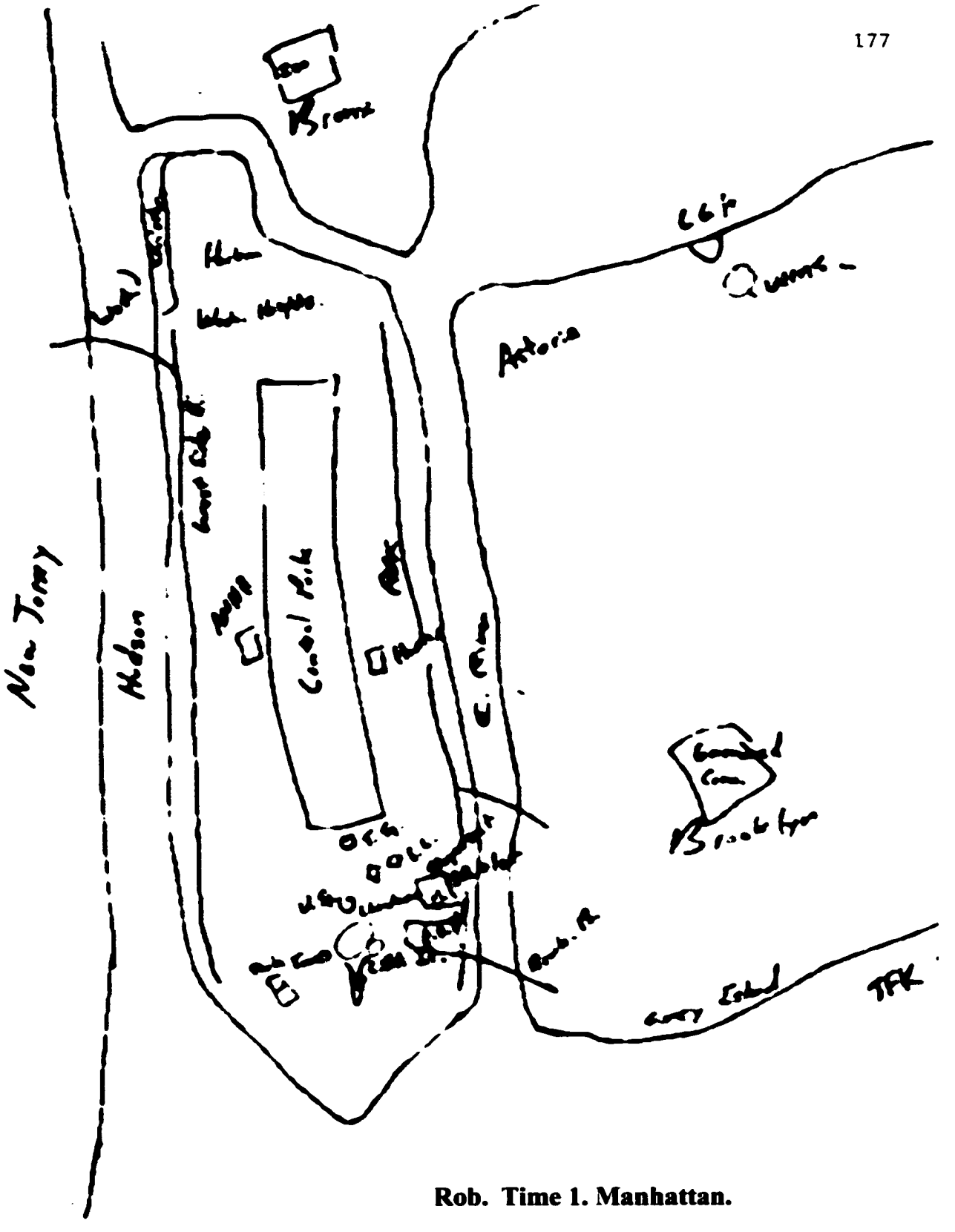
Mary. Time 1. Route 1



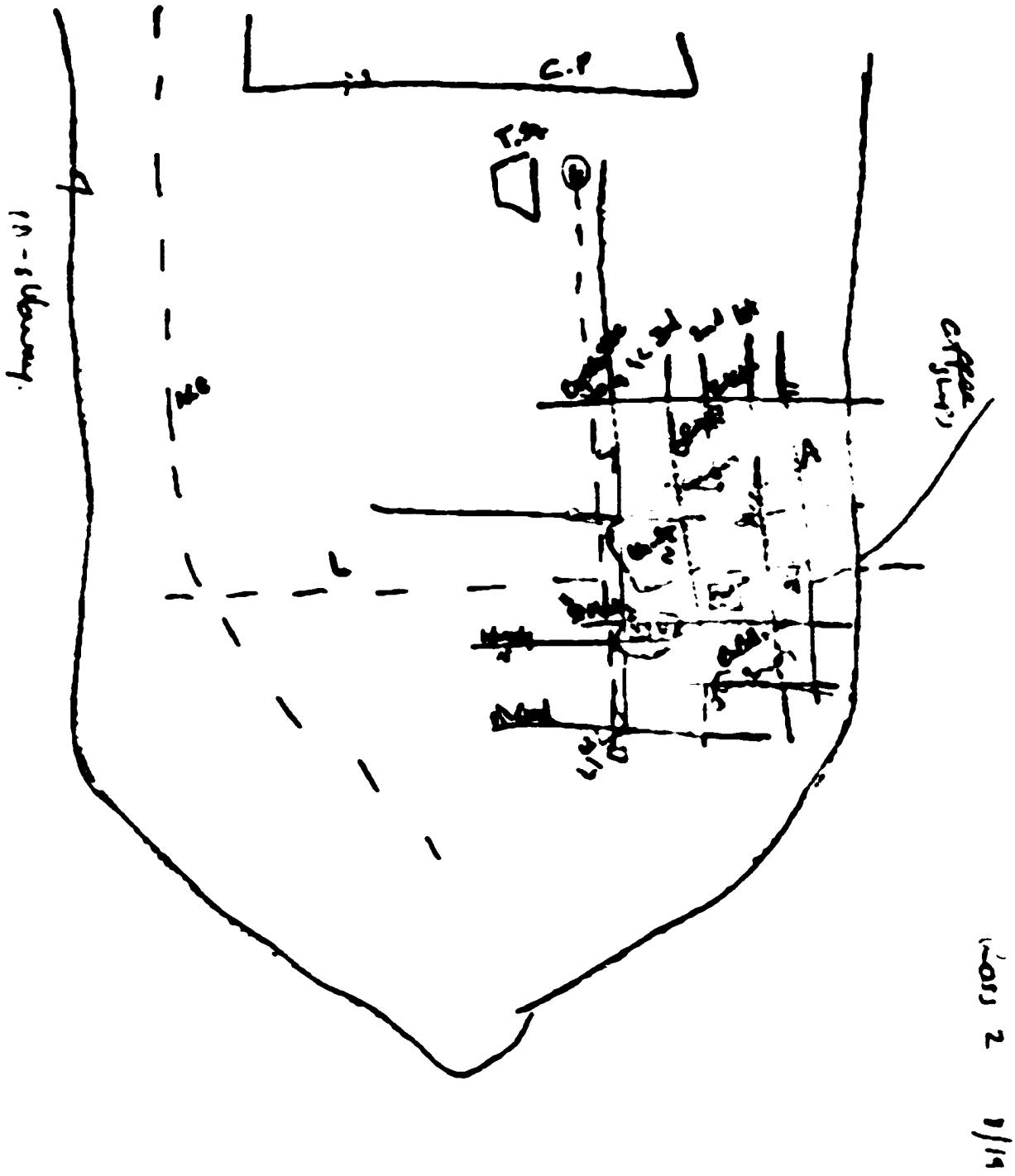
Mary. Time 2. Route 2



Mary. Time 3. Route 3



Rob. Time 1. Manhattan.



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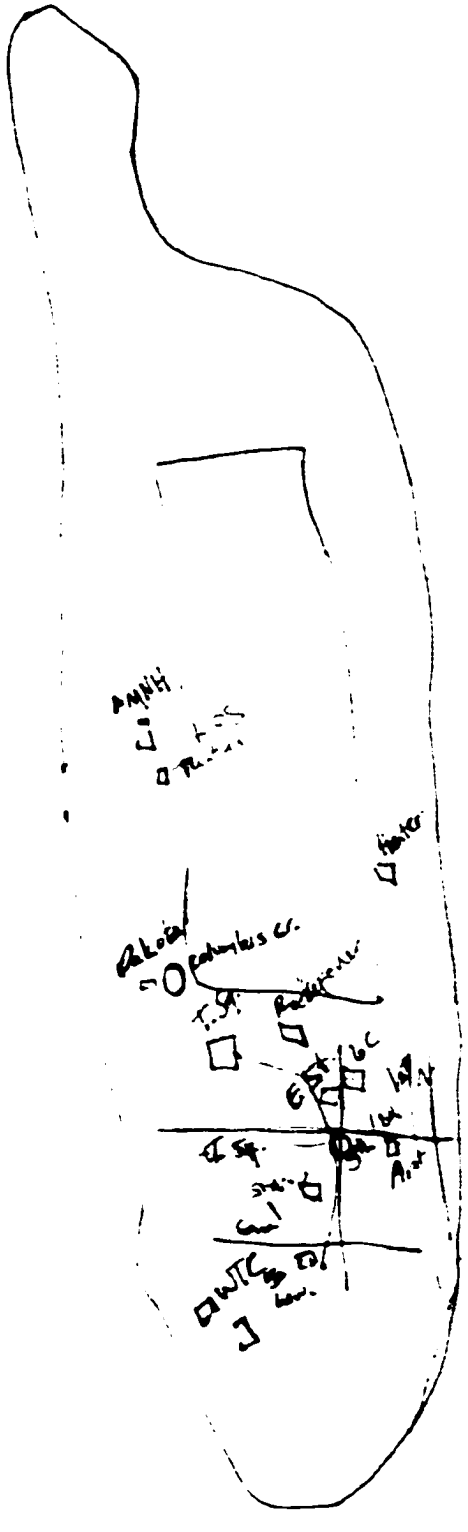
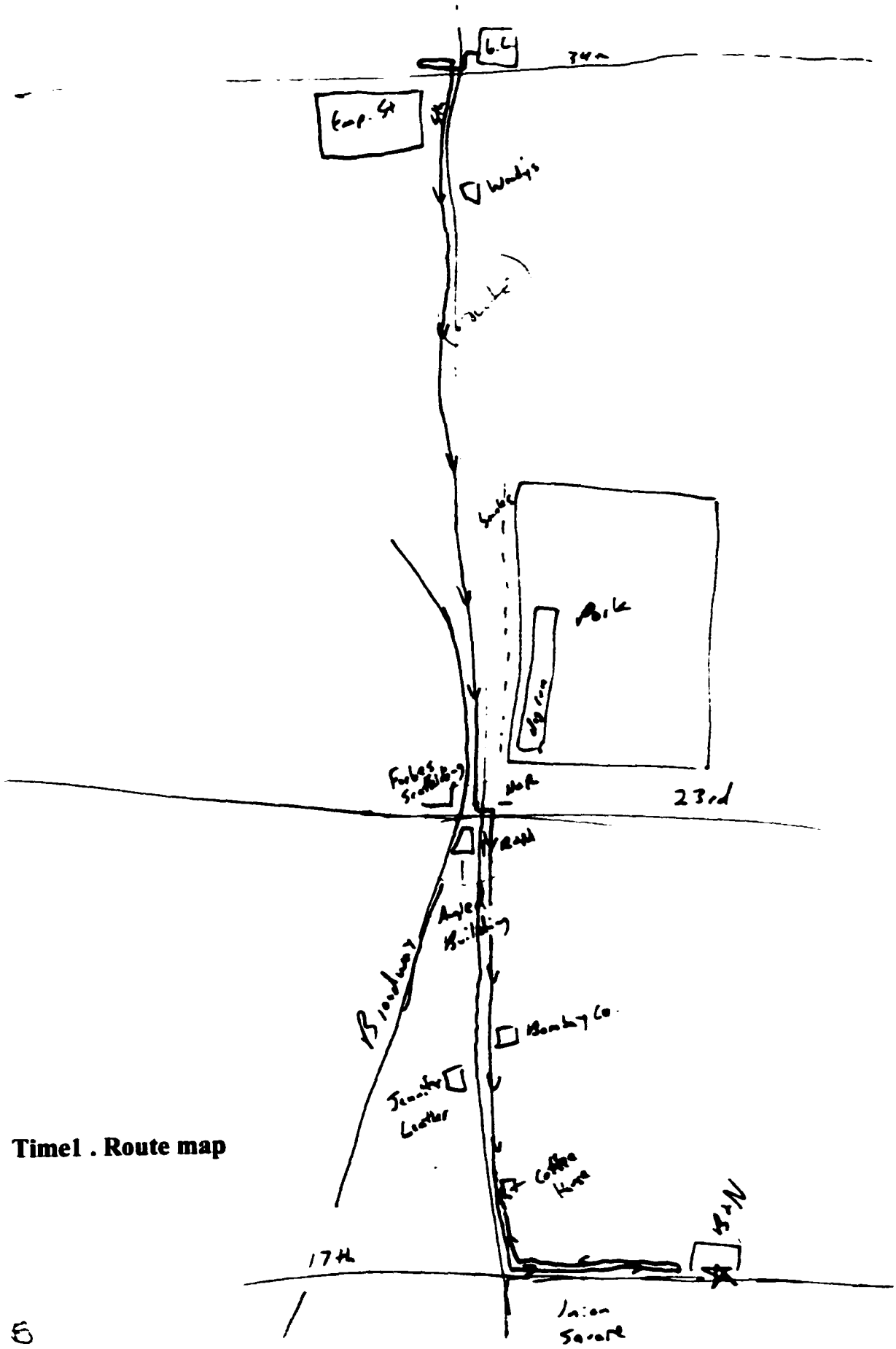
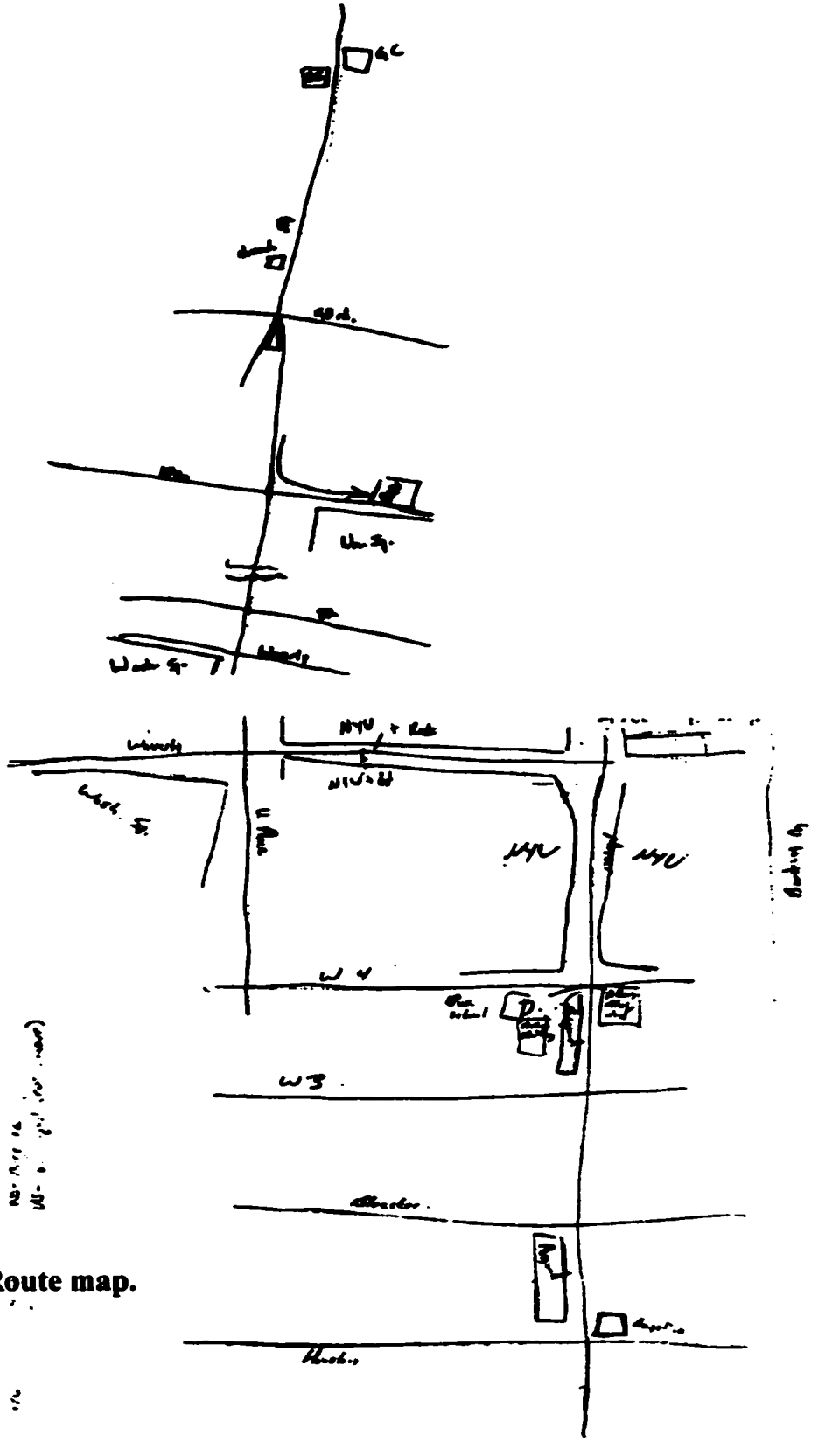


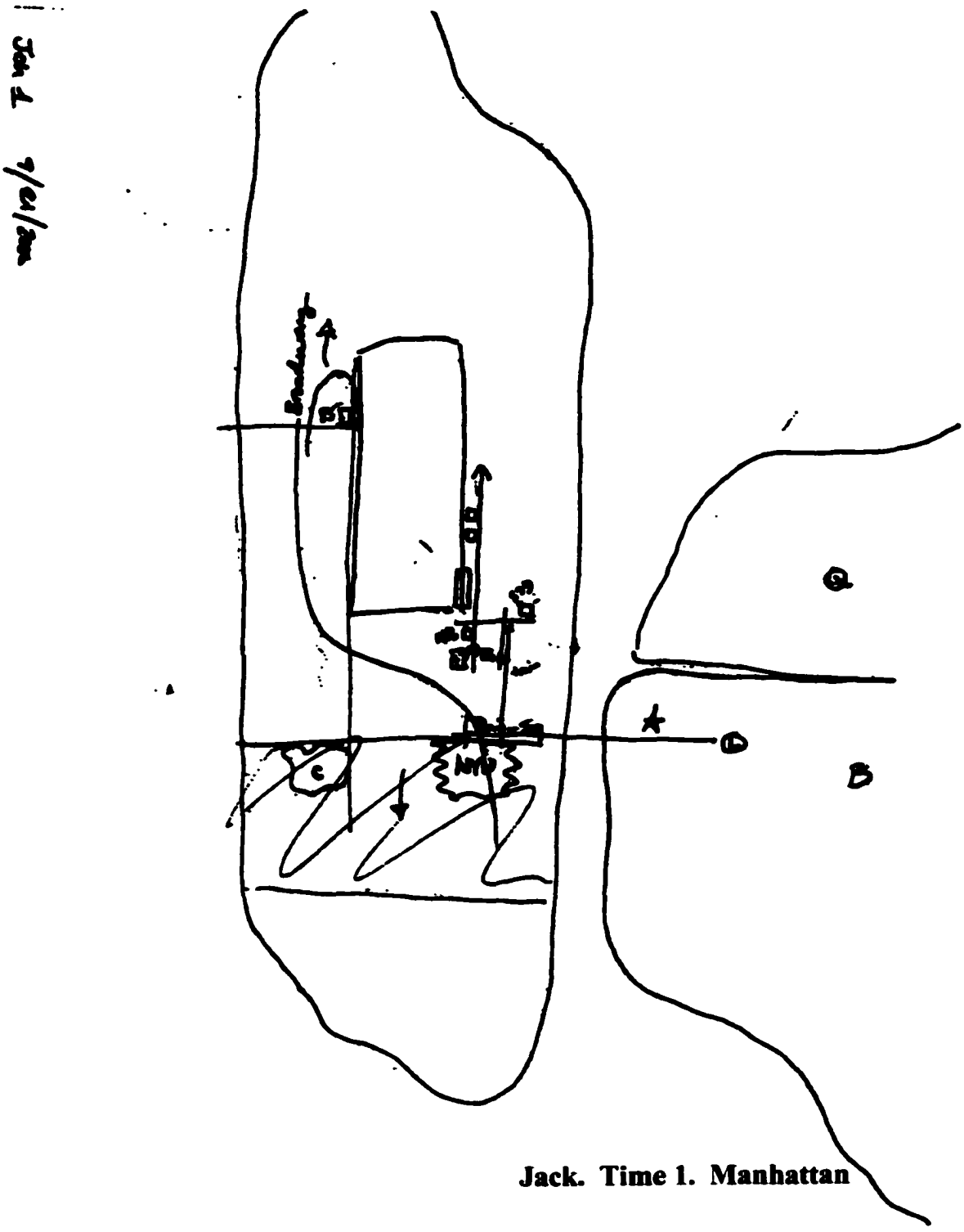
Rob. Time 3. Manhattan.



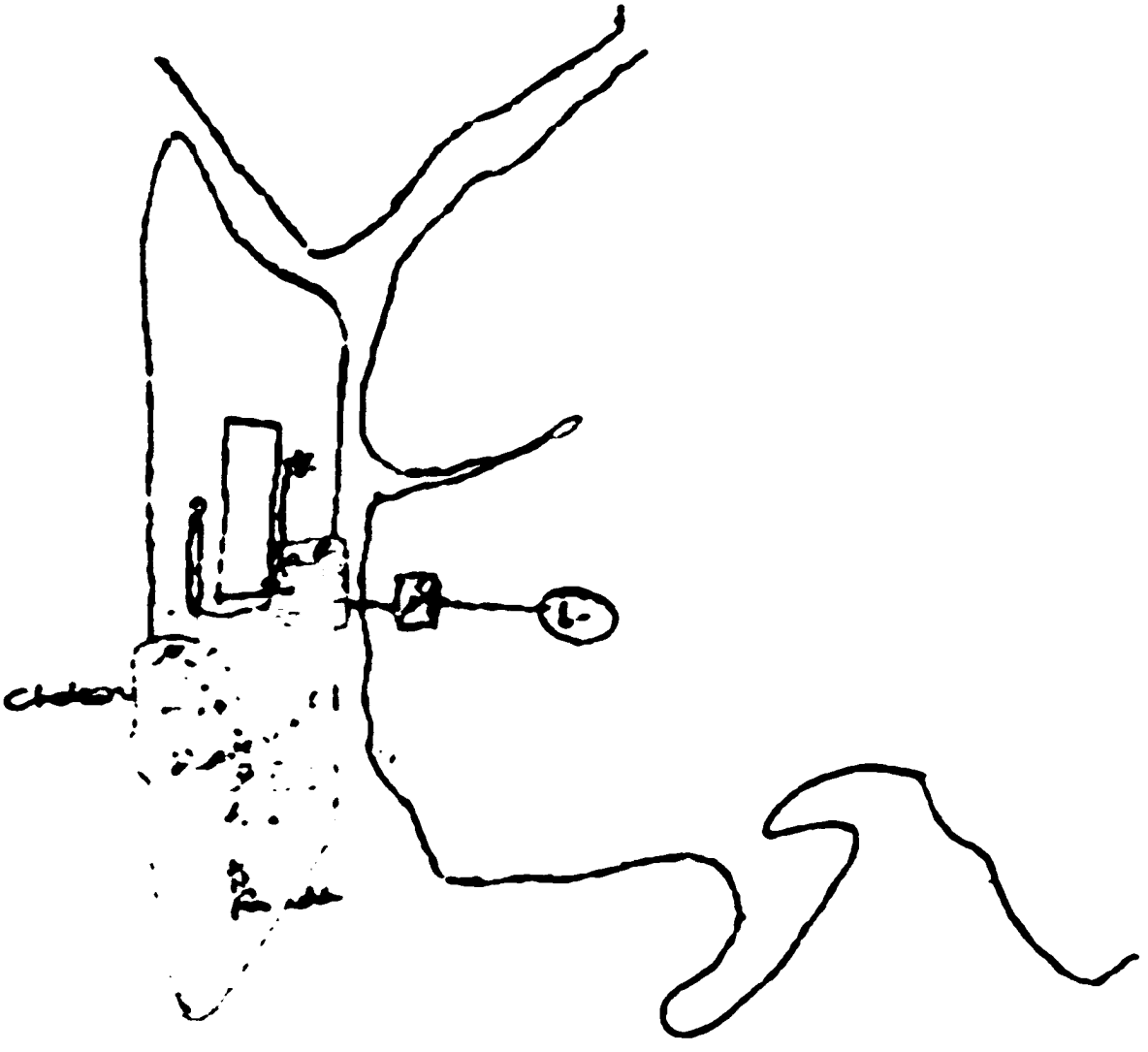
Rob. Time1 . Route map



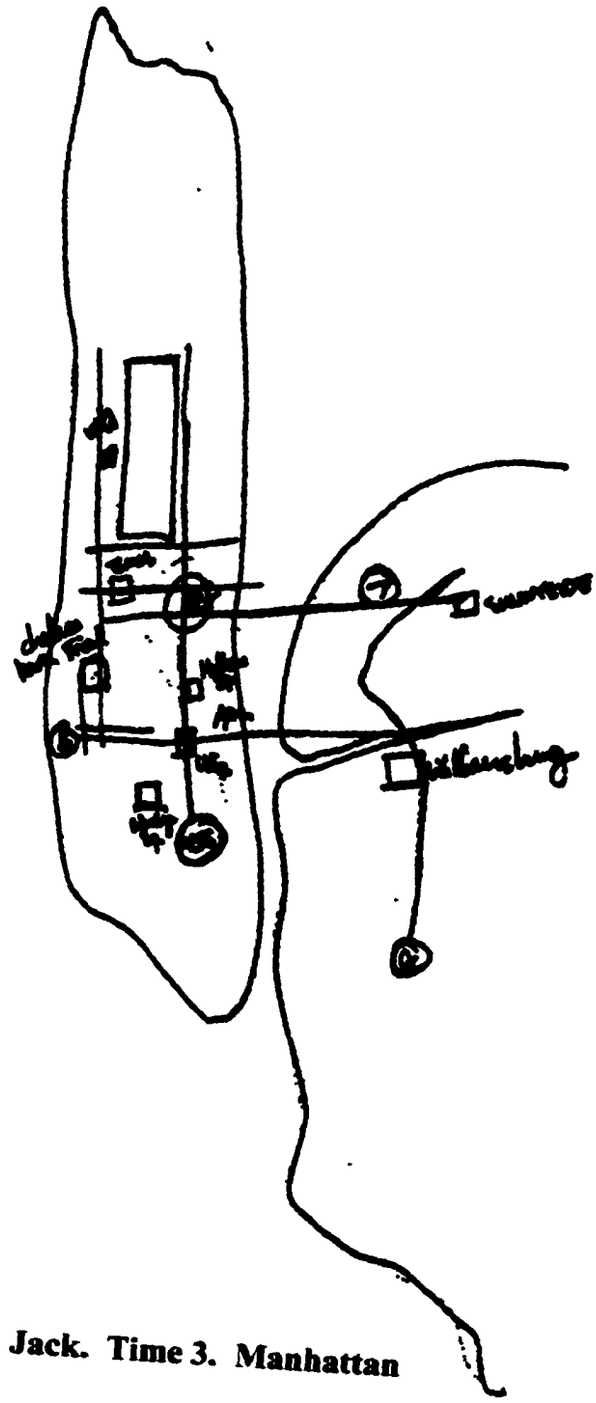
Rob. Time 3. Route map.



Jack. Time 1. Manhattan

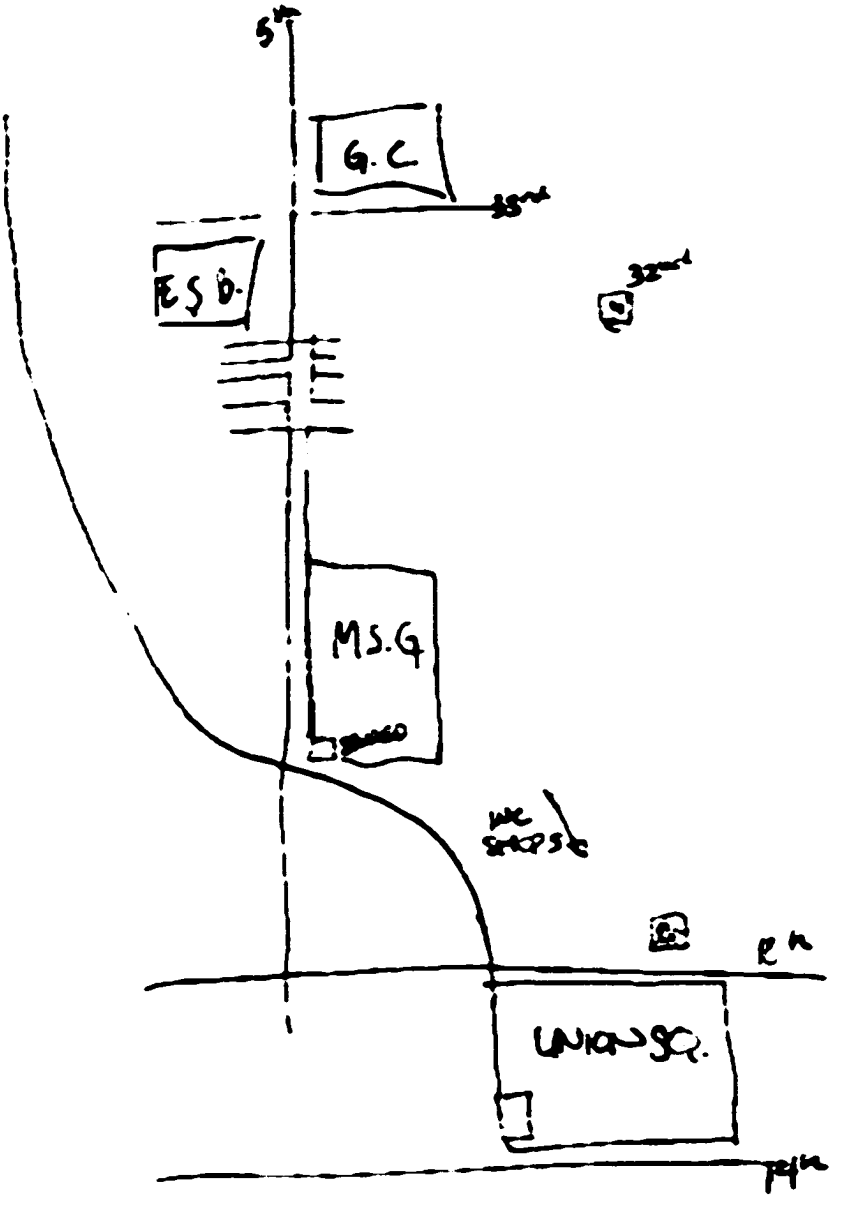


Jack. Time 2. Manhattan

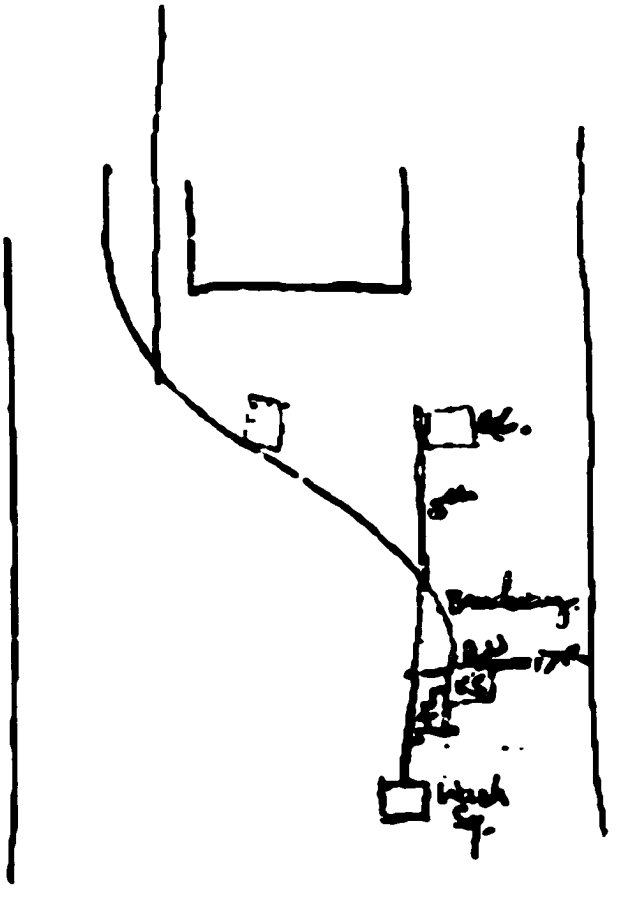


Jack. Time 3. Manhattan

JON 3 12/1



Jack. Time 1. Route map



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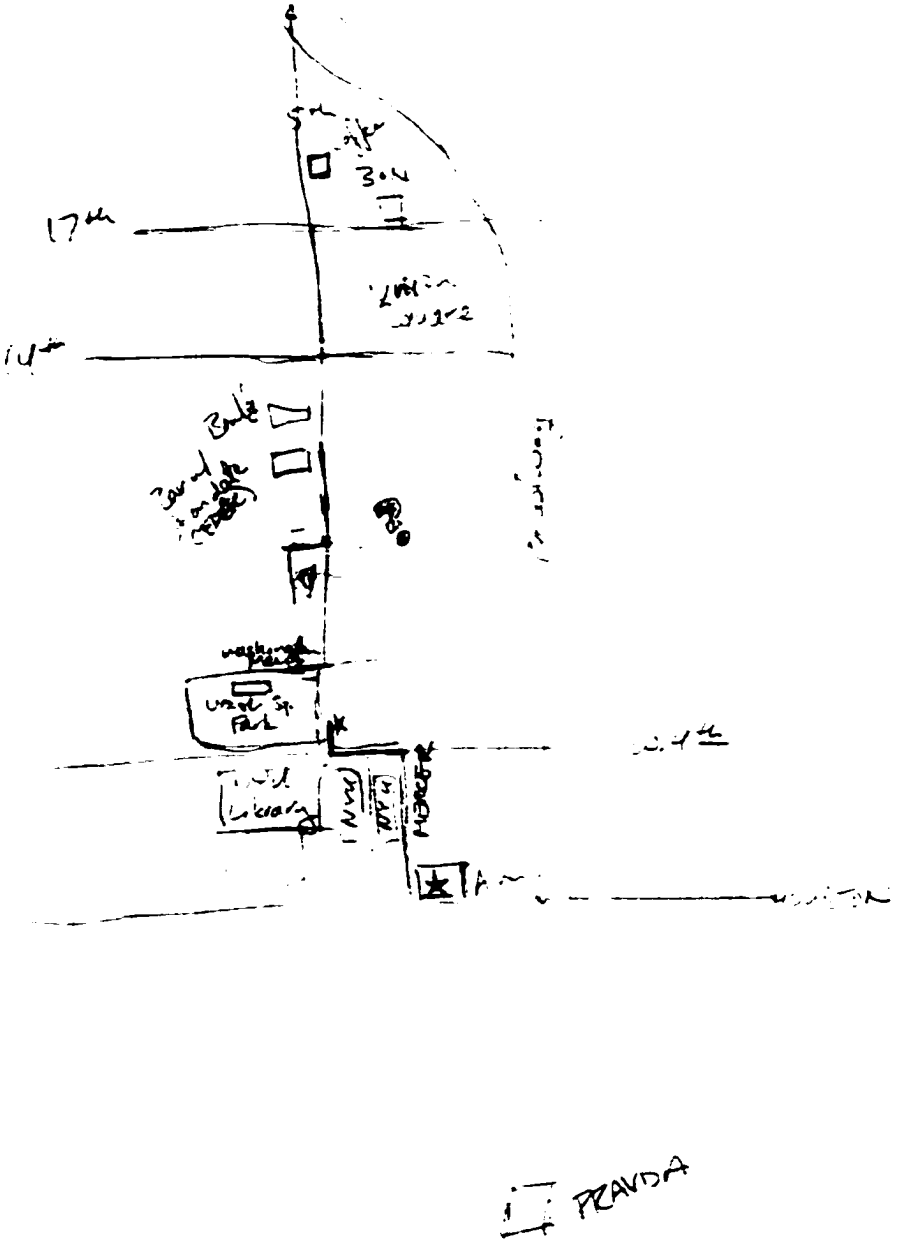
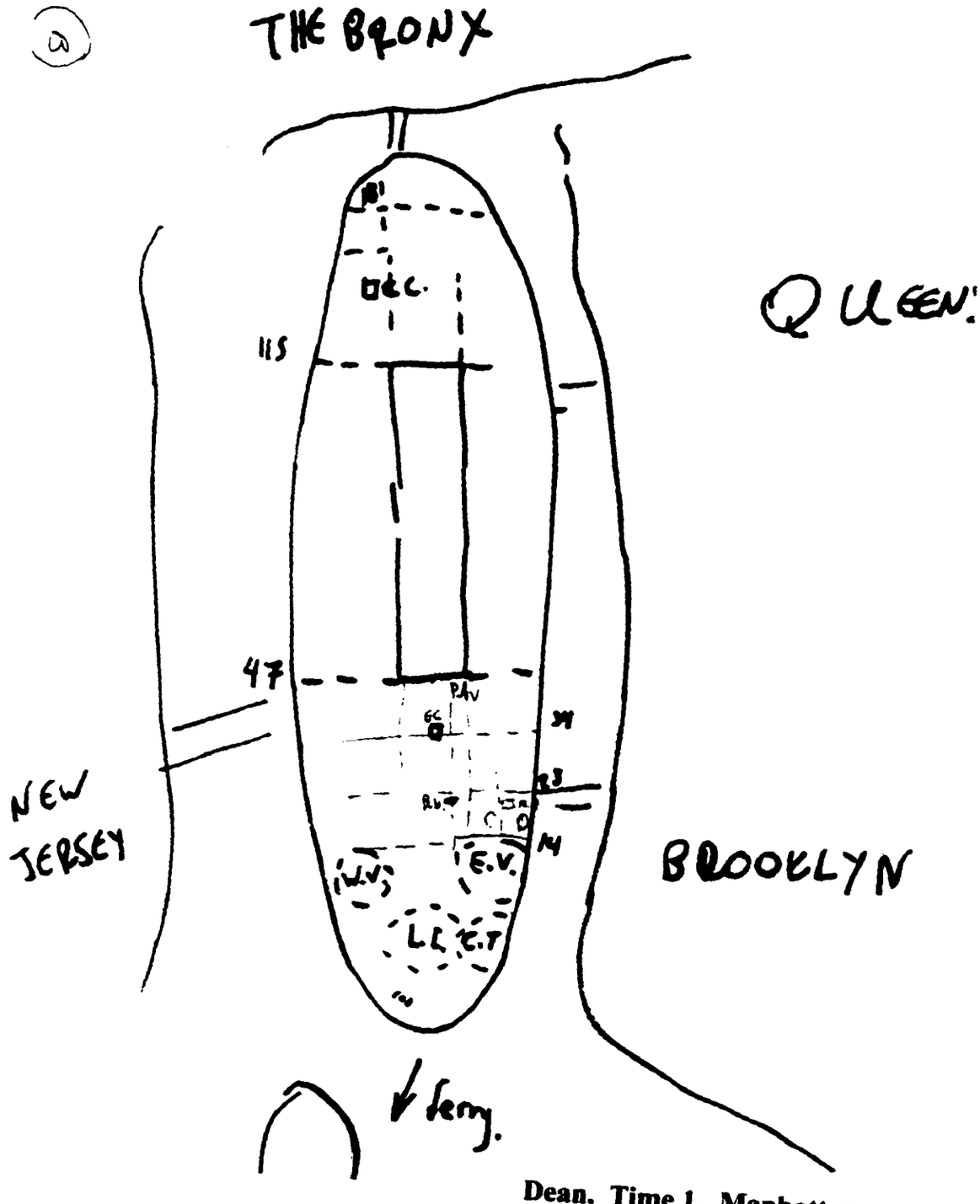
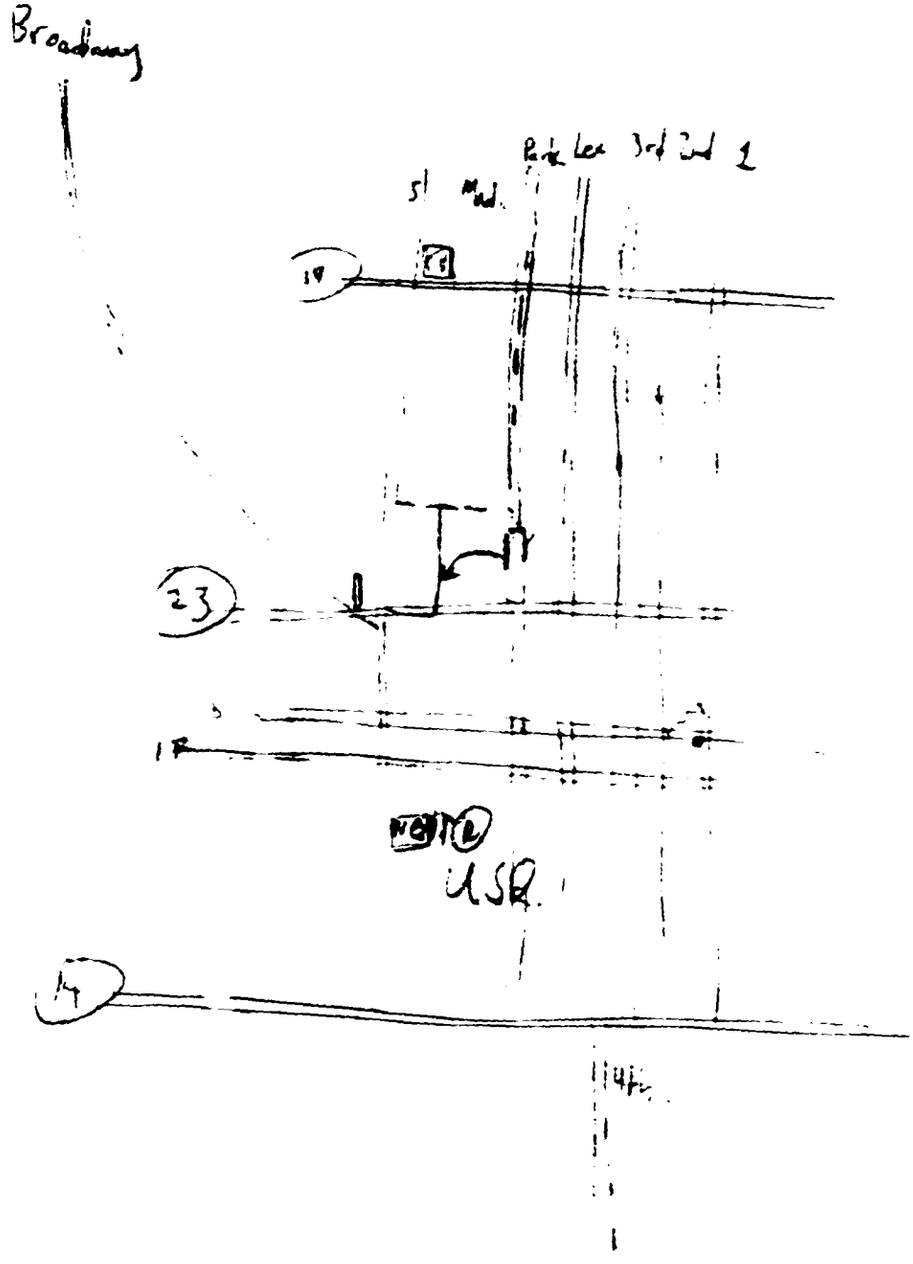


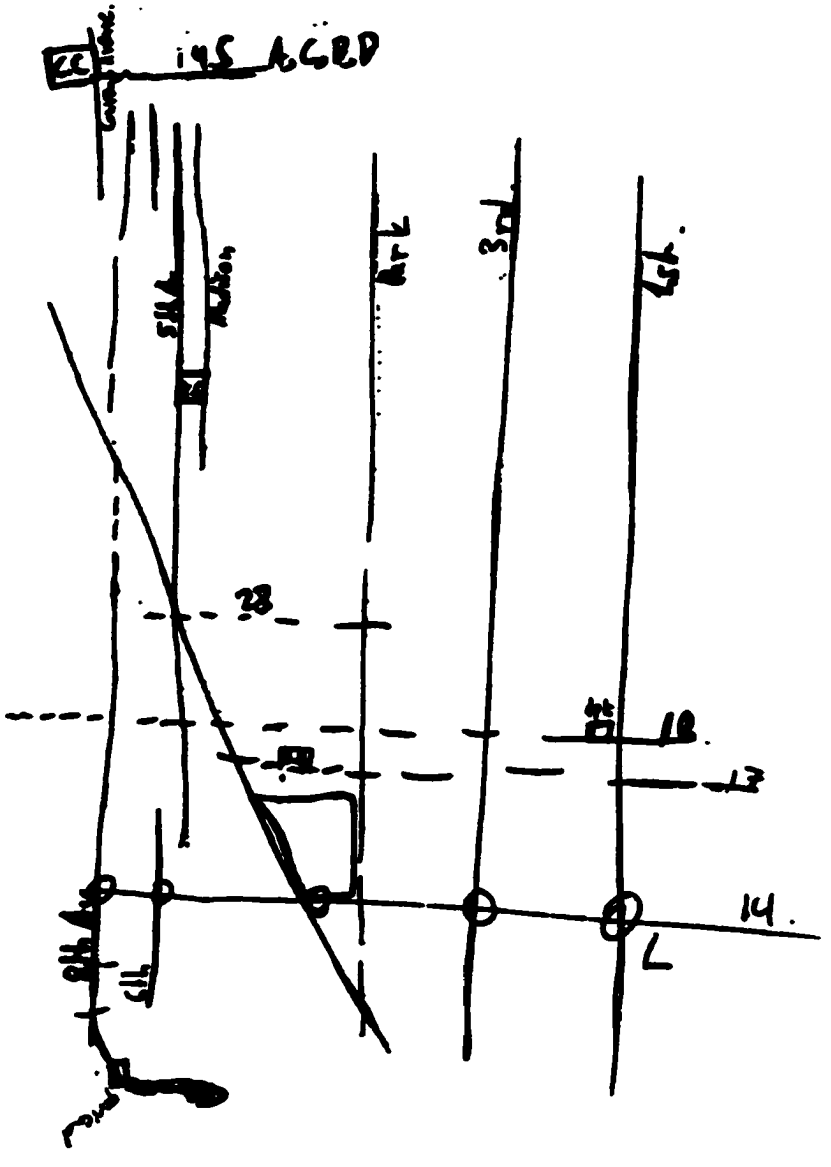
Jack. Time 3. Route map



Dean. Time 1. Manhattan.



Dean. Time 2. Midtown Manhattan.



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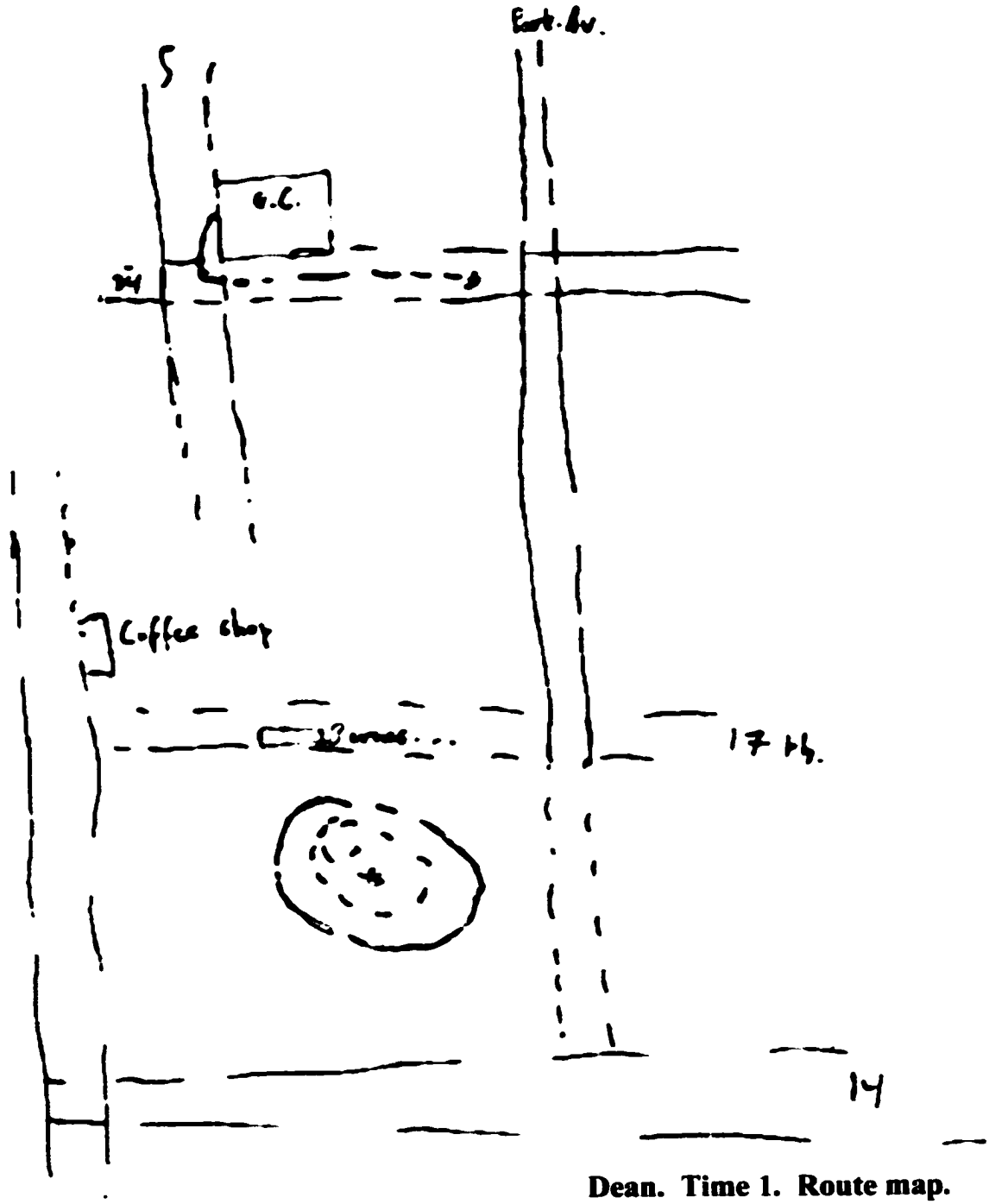
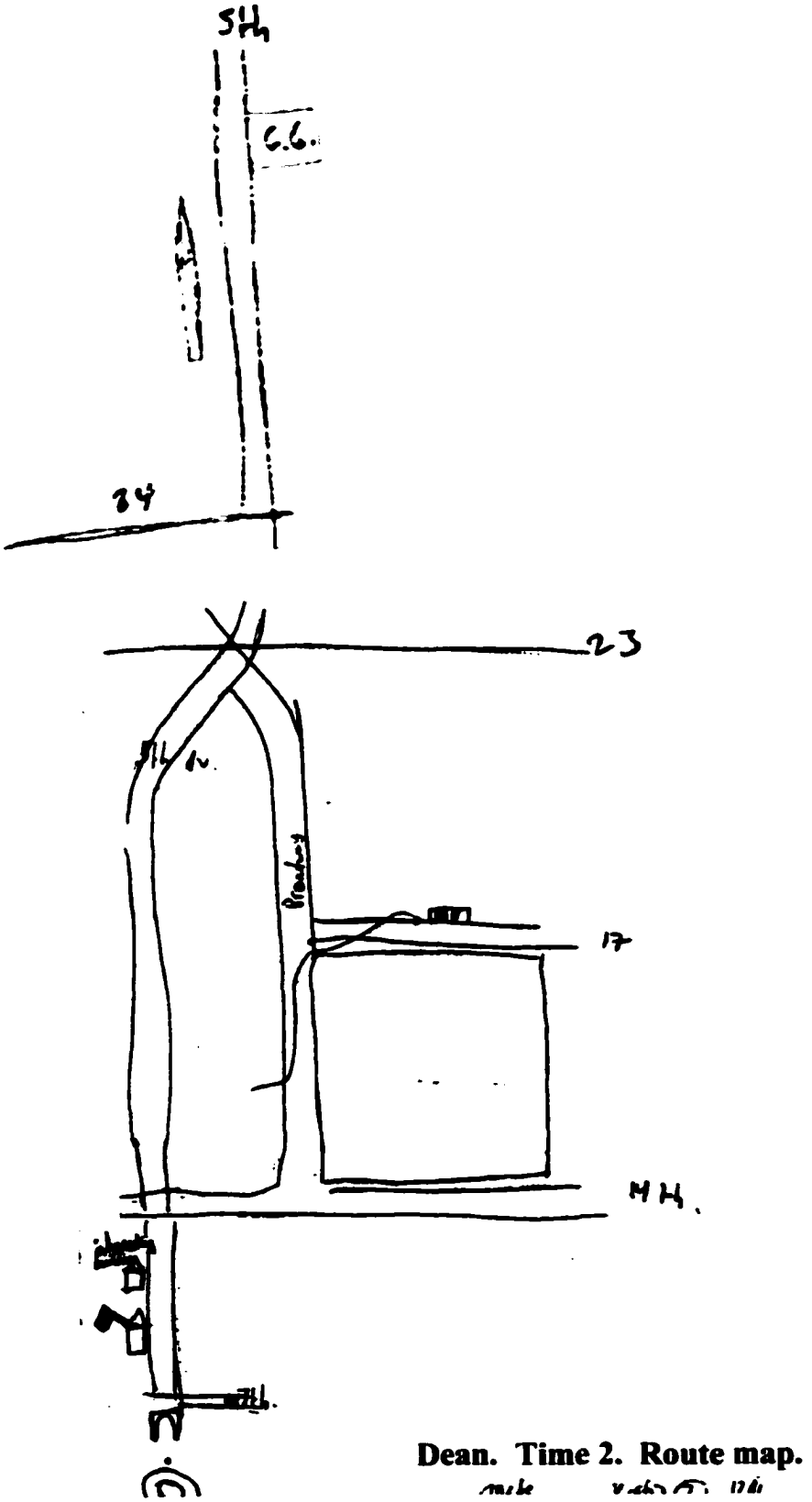


Dean. Time 1. Route map.



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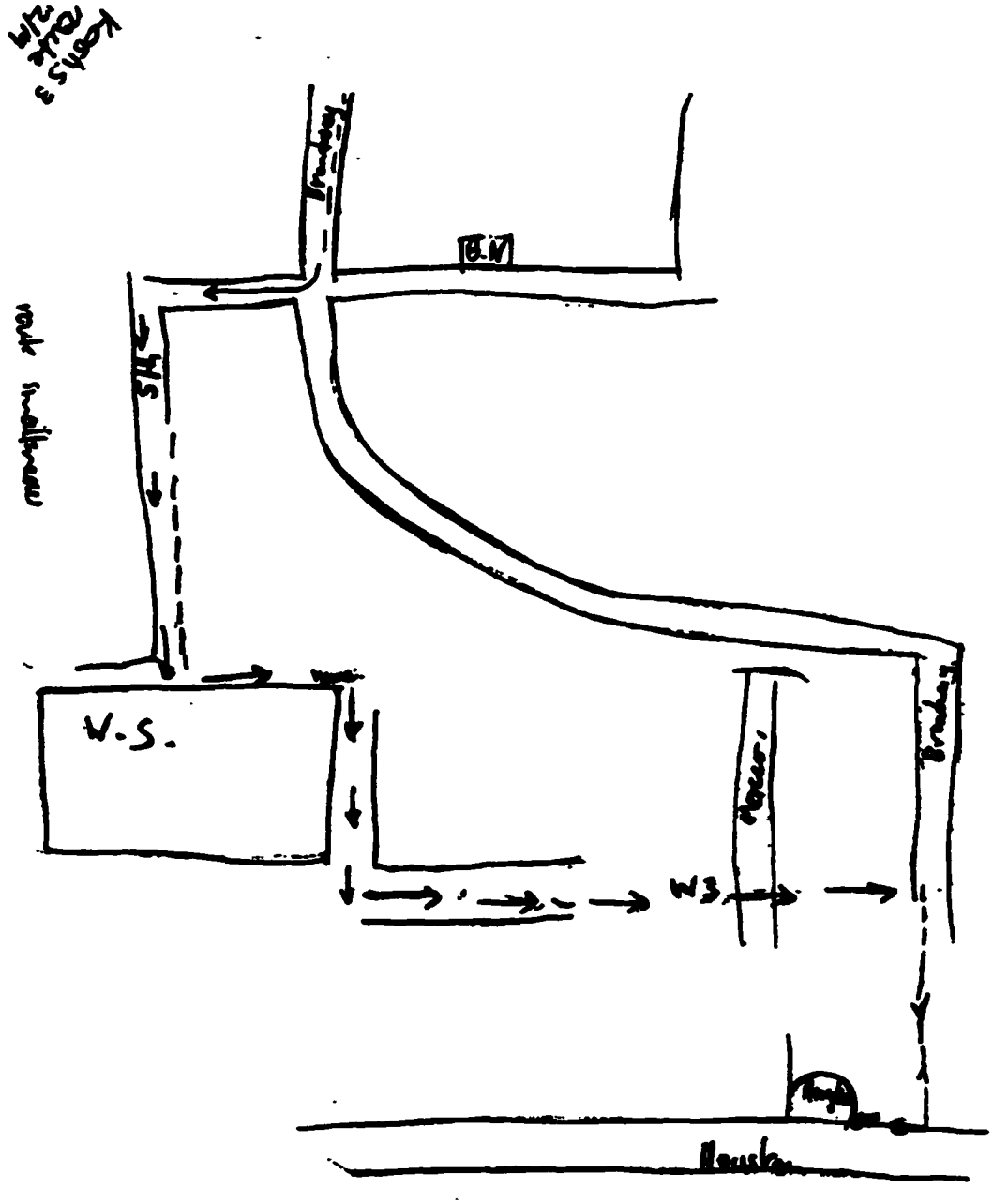

Dean. Time 3. Route map.

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