Fellmann Migration: Gravity Model

Early in January of 1849 we first thought of migrating to California. It was a period of National hard times . . . and we longed to go to the new El Dorado and "pick up" gold enough with which to return and pay off our debts.

Our discontent and restlessness were enhanced by the fact that my health was not good. . . . The physician advised an entire change of climate thus to avoid the intense cold of Iowa, and recommended a sea voyage, but finally approved of our contemplated trip across the plains in a "prairie schooner."

Full of the energy and enthusiasm of youth, the prospects of so hazardous an undertaking had no terror for us, indeed, as we had been married but a few months, it appealed to us as a romantic wedding tour.[1]

So begins Catherine Haun's account of their 9-month journey from Iowa to California, just two of the quarter-million people who traveled across the continent on the Overland Trail in one of the world's great migrations. The migrants faced months of grueling struggle over badly marked routes that crossed swollen rivers, deserts, and mountains. The weather was often foul, with hailstorms, drenching rains, and burning summer temperatures. Graves along the route were a silent testimony to the lives claimed by buffalo stampedes, Indian skirmishes, cholera epidemics, and other disasters.

What inducements were so great as to make emigrants leave behind all that was familiar and risk their lives on an uncertain venture? Catherine Haun alludes to economic hard times gripping the country and to their hope for riches to be found in California. Like other migrants, the Hauns were attracted by the climate in the West, which was said to be always sunny and free of disease. Finally, like most who undertook the perilous journey West, the Hauns were young, moved by restlessness, a sense of adventure, and a perception of greater opportunities in a new land. They, like their predecessors back to the beginnings of humankind, were acting in space and across space on the basis of acquired information and anticipation of opportunity—prepared to pay the price in time, money, and hardship costs of overcoming distance.

A fundamental question in human geography is: What considerations influence how individual human beings use space and act within it? Related queries include: Are there discernible controls on human spatial behavior? How does distance affect human interaction? How do our perceptions of places influence our spatial activities? How do we overcome the consequences of distance in the exchange of commodities and information? How are movement and migration decisions (like that of the Hauns) reached? How have new technologies enabled increased spatial interaction across great distances and contributed to globalization? These are questions addressing geography's concern with understanding spatial interaction.

Spatial interaction means the movement of peoples, ideas, and commodities (goods bought and sold) within and between areas. The Hauns were engaging in spatial interaction (Figure 3.1). International trade, the movement of semitrailers on the expressways, radio broadcasts, and business or personal telephone calls are more familiar examples. Such movements and exchanges are designed to achieve effective integration between different points

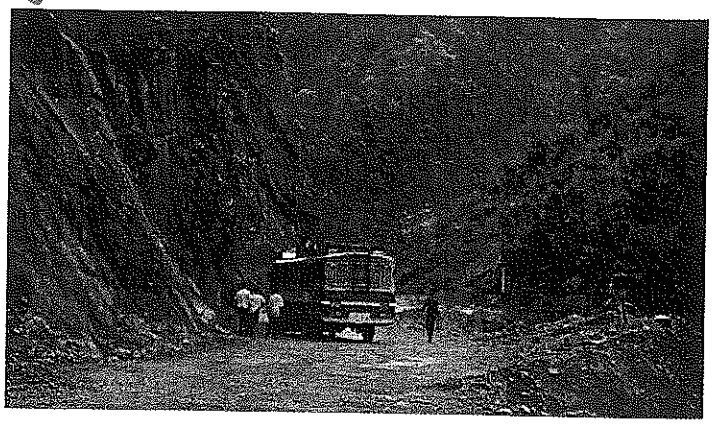


Figure 3.1 A public bus negotiates a washed-out section of highway on one of the major routes connecting the capital city of Kathmandu with southern Nepal and India. Movement in Nepal is more difficult than in developed countries because of the limited road network, narrow, winding mountain roads, and frequent landslides. A ride on a public bus in Nepal can be an adventure in sharing space with people, agricultural produce, and livestock.

of human activity. Movement of whatever nature satisfies some felt need or desire. It represents the attempt to smooth out the spatially differing availability of required resources, commodities, information, or opportunities. Whatever the particular purpose of a movement, there is inevitably some manner of trade-off balancing the benefit of the interaction with the costs that are incurred in overcoming spatial separation. Because commodity movements represent simple demonstrations of the principles underlying all spatial interactions, let us turn to them first.

Bases for Interaction

Neither the world's resources nor products are uniformly distributed. Commodity flows are responses to these differences; they are links between points of supply and locales of demand. Such response may not be immediate or even direct. Matters of awareness of supplies or markets, the presence or absence of transportation connections, costs of movement, ability to pay for things wanted and needed—all and more are factors in the structure of trade. Underlying even these, however, is a set of controlling principles governing spatial interaction.

A Summarizing Model

Geographer Edward Ullman (1912–1976) speculated on the essential conditions affecting such interactions and proposed an explanatory model. He observed that spatial interaction is effectively controlled by three flow-determining factors that he called *complementarity, transferability,* and *intervening opportunity.* Although Ullman's model deals with commodity flows, it has—as we shall see—applicability to information transfers and human movements as well.

Complementarity

For two places to interact, one place must have what another place wants and can secure. That is, one place must have a supply of

[1]From Catherine Haun, "A Woman's Trip across the Plains in 1849," in Lillian Schlissel, *Women's Diaries of the Westward Journey.* (New York: Schocken Books, 1982).

an item for which there is an effective demand in the other, as evidenced by desire for the item, purchasing power to acquire it, and means to transport it. The word describing this circumstance is **complementarity.** *Effective* supply and demand are important considerations; mere differences from place to place in commodity surplus or deficit are not enough to initiate exchange. Greenland and the Amazon basin are notably unlike in their natural resources and economies, but their amount of interaction is minimal. Supply and market must come together, as they do in the flow of seasonal fruits and vegetables from California's Imperial Valley to the urban markets of the American Midwest and East or in the movement of manganese from Ukraine to the steel mills of Western Europe. The massive movement of crude and refined petroleum clearly demonstrates complementarity in international trade (Figure 3.2). More generalized patterns of complementarity underlie the exchanges of the raw materials and agricultural goods of less developed countries for the money or industrial commodities of the developed states.

Transferability

Even when complementarity exists, spatial interaction occurs only when conditions of **transferability**—acceptable costs of an exchange—are met. Spatial movement responds not just to availability and demand but to considerations of time and cost. Transferability is an expression of the mobility of a commodity and is a function of three interrelated conditions: (1) the characteristics and value of the product; (2) the distance, measured in time and money penalties, over which it must be moved; and (3) the ability of the commodity to bear the costs of movement. If the time and money costs of traversing a distance are too great, exchange does not occur. That is, mobility is not just a physical matter but an economic one as well. If a given commodity is not affordable upon delivery to an otherwise willing buyer, it will not move in trade, and the potential buyer must seek a substitute or go without.

Transferability is not a constant condition. It differs between places, over time, depending upon what is being transferred and how it is to be moved. In the 1820s, the newly opened Erie Canal cut shipping costs from Buffalo to New York City by 90%. More recently, containerized shipping has had a similar effect on the global shipments of goods. An increasing scarcity of high-quality ores will enhance the transferability of lower-quality mine outputs by increasing their value. Low-cost bulk commodities not economically moved by air may be fully transferable by rail or water. Poorly developed and costly transportation may inhibit exchanges even at short distance between otherwise willing traders. In short, transferability expresses the changing relationships between the costs of transportation and the value of the product to be shipped.

Intervening Opportunity

Complementarity can be effective only in the absence of more attractive alternative sources of supply or demand closer at hand or cheaper. **Intervening opportunities** serve to reduce supply/demand interactions that otherwise might develop between distant complementary areas. A supply of Saharan sand is not enough to assure its flow to sand-deficient Manhattan Island because supplies of sand are more easily and cheaply available within the New York metropolitan region. For reasons of cost and convenience, a purchaser is unlikely to buy identical commodities at a distance when

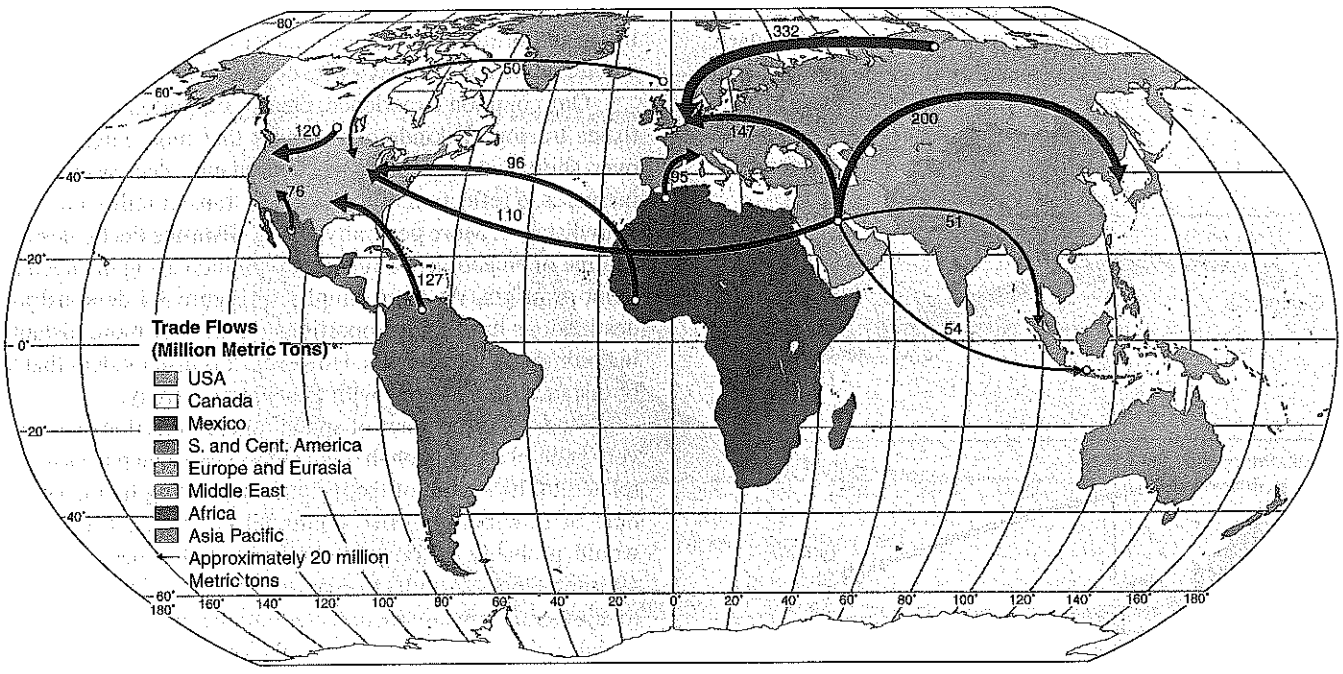


Figure 3.2 Major international crude oil and other product exports flow, 2007. Complementarity is so basic in initiating interaction that even relatively low-value bulk commodities such as coal, fertilizer, and grain move in trade over long distances. For many years, despite fluctuating prices, petroleum has been the most important commodity in international trade, moving long distances in response to effective supply and demand considerations.

Source: Adapted from The BP Amoco Statistical Review of World Energy, *2008.*

a suitable nearby supply is available. When it is, the intervening opportunity demonstrates complementarity at a shorter distance.

Similarly, markets and destinations are sought, if possible, close at hand. Growing metropolitan demand in California reduces the importance of midwestern markets for western fruit growers. The intervening opportunities offered by Chicago or Philadelphia reduce the number of job seekers from Iowa searching for employment in New York City. People from New England are more likely to take winter vacations in Florida, which is relatively near and accessible, than in Southern California, which is not. That is, opportunities that are discerned closer at hand reduce the pull of opportunities offered by a distant destination (Figure 3.3). Patterns of spatial interaction are dynamic, reflecting the changeable structure of apparent opportunity.

Measuring Interaction

Complementarity, transferability, and intervening opportunity—the controlling conditions of commodity movement—help us understand all forms of spatial interaction, including choosing a restaurant, where to go to college, or where to buy a house, and the once-in-a-lifetime transcontinental adventure of the Hauns. The study of unique spatial interactions such as the discovery of an Inuit (Eskimo) carving in a Miami gift shop is interesting but does not establish general patterns. In this chapter we focus on general principles that govern the frequency and intensity of interaction both to validate the three preconditions of spatial exchange and to establish the probability that any given potential interaction will actually occur. Our interest is similar to that of the physical scientist investigating, for example, the response of a gas to variations in temperature and pressure. The concern there is with *all* of the gas molecules and the probability of their collective reactions; the action of any particular molecule is of little interest. Similarly, we are concerned here with the probability of aggregate, not individual, behavior.

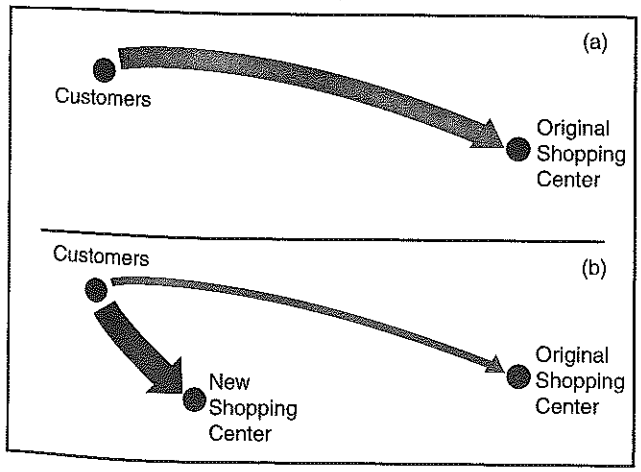


Figure 3.3 (*a*) The volume of expected customers for a shopping mall based solely on their complementarity and distance apart, may be (*b*) reduced if a new mall opens as an intervening opportunity nearer to the customers.

That concern with aggregate behavior conceals or ignores a great deal of spatial interaction of vital importance both in the real world and in human geography. Most theoretical and observational studies of spatial interaction have focused on the standard normative spatial behavior of fully physically and economically capable Western-culture adults. That standard does not address the individual or collective spatial problems and actions of such others as children, the poor, the elderly, the handicapped, or socially disadvantaged individuals or groups, nor does it recognize the very real, though often subtle, differences between male and female spatial action responses and decisions. Our orientation to the North American culture realm means also that the aggregate spatial behavioral norms we discern there fail to recognize the many and varied sociocultural, economic, religious, legal, and similar constraints on spatial behavior operative in other culture areas of the world. Nevertheless, observational evidence suggests that the same basic influences on personal spatial behavior we recognize here have universal applicability despite their inevitable modification in different contexts.

Distance Decay

In all manner of ways, the lives and activities of people everywhere are influenced by the **friction of distance.** That phrase reminds us that distance has a retarding effect on human interaction because there are increasing penalties in time and cost associated with longer-distance, more expensive interchanges. We visit nearby friends more often than distant relatives; we go more frequently to the neighborhood convenience store cluster than to the farther regional shopping center. Telephone calls or mail deliveries between nearby towns are greater in volume than those to more distant locations. An informal study showed that college students living in dormitories near the cafeteria are more likely to use the cafeteria; students farther away do not visit the cafeteria as often.

Our common experience, clearly supported by maps and statistics tracing all kinds of flows, is that most interactions occur over short distances. That is, interchange decreases as distance increases, a reflection of the fact that transferability costs increase with distance. More generally stated, **distance decay** describes the decline of an activity or function with increasing distance from its point of origin. As the examples in Figure 3.4 demonstrate, near destinations have a disproportionate pull over more distant points in commodity movements. However, it is also evident that the rate of distance decay varies with the type of activity.

Study of all manner of spatial interconnections has led to the very general conclusion that interaction between places is inversely related to the square of the distance separating them. That is, volume of flow between two points 80 kilometers (50 miles) apart would probably be only one-quarter of that between centers at 40 kilometers (25 miles) separation. Such a rigid *inverse-square* relationship is well documented in the physical sciences. For social, cultural, and economic relations, however, it is at best a useful approximation. In human interaction, linear distance is only one aspect of transferability; cost and time are often more meaningful measures of separation.

When the friction of distance is reduced by lowered costs or increased ease of flow, the slope of the distance decay curve is

flattened and more total area is effectively united than when those costs are high. When automobiles and expressways became widely available in the second half of the 20th century, U.S. cities underwent massive geographic expansion as the friction of distance was sharply reduced and large areas of rural land were brought within a reasonable commute time from the city. Figure 3.4 shows that distance decay is evident for both truck and rail shipments but that the more expensive mode (trucking) is typically used for shorter distances.

The Gravity Concept

Interaction decisions are not based on distance or distance/cost considerations alone. The large regional shopping center attracts customers from a wide radius because of the variety of shops and goods its very size promises. We go to distant big cities "to seek our fortune" rather than to the nearer small town. We are, that is, attracted by the expectation of opportunity that we associate with larger rather than smaller places. That expectation is summarized by another model of spatial interaction, the **gravity model,** also drawn from the physical sciences.

In the 1850s, Henry C. Carey (1793–1879), in his *Principles of Social Science,* observed that the physical laws of gravity and motion developed by Sir Isaac Newton (1642–1727) were applicable to the aggregate actions of humans. Newton's *law of universal gravitation* states that the attractive pull between any two objects is proportional to the product of their masses and inversely proportional to the square of the distance between them. More simply put, Newton's law tells us that big things have a stronger attraction force (greater gravitational pull) than do small objects and that things close to each other have stronger mutual attraction than do objects at greater distance—and that the attraction decreases very rapidly with even small increases in separation.

Carey's interests were in the interaction between urban centers and in the observation that a large city is more likely to attract an individual than is a small hamlet. His first interest could be quickly satisfied by simple analogy. He assumed that the expected interaction between two places can be calculated by converting physical mass in the gravity model to population size while retaining the distance component of the Newtonian calculation (for the applicable Newton and Carey equations, see *gravity model* in the Glossary).

In social science applications of the gravity model, distance may be calculated by travel time or travel cost modifications rather than by straight line separation. Whatever the unit of measure, however, the model assures us that although spatial interaction always tends to decrease with increasing distance between places, at a given distance it tends to expand with increases in the size of the places.

Carey's second observation—that large cities have greater drawing power for individuals than do small ones—was subsequently addressed by the **law of retail gravitation,** proposed by William J. Reilly (1899–1970) in 1931. Using the population and distance inputs of the gravity model, Reilly determined the relative amount of retail trade that two cities would attract from an intermediate place in the vicinity of the *breaking point (BP).*[2] **Reilly's law** (see the Glossary for the algebraic expression) states that two cities will attract trade from intermediate locales in direct

[2]The breaking point between two towns is defined as the point up to which one town exerts the controlling retail trade influence and beyond which the other town dominates.

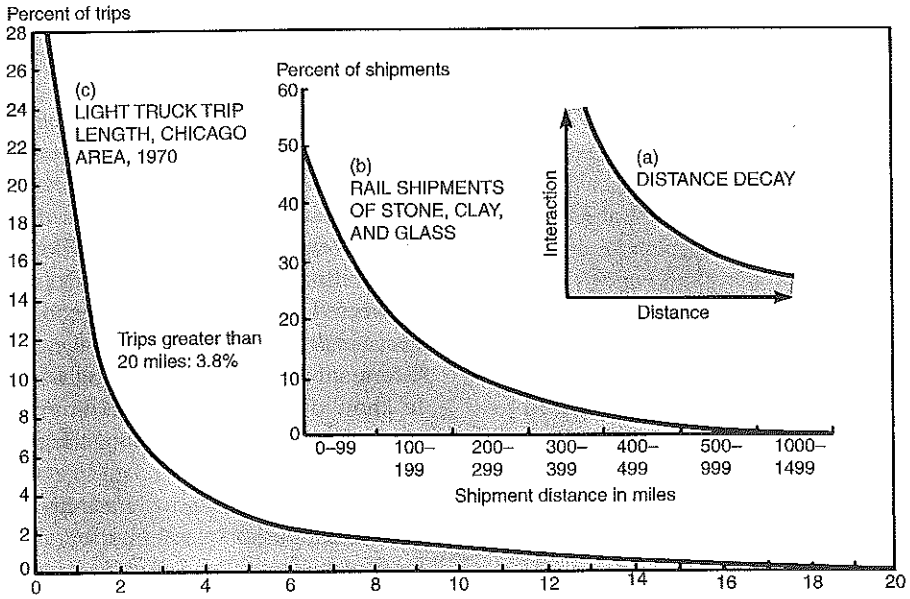


Figure 3.4 The shape of distance decay. The geographer W. Tobler summarized the concept of distance decay in proposing his "first law of geography: everything is related to everything else, but near things are more related than distant things." Distance decay curves vary with the type of flow. (*a*) is a generalized statement of distance decay, (*b*) summarizes United States data for a single year, and (*c*) suggests the primary use of light trucks as short haul pickup and delivery vehicles.

Source: (c) Data from Chicago Area Transportation Study, A Summary of Travel Characteristics, *1977.*

proportion to the populations of the two cities and in inverse proportion to the square of the distance of these two cities to the intermediate place.

Any farm or small-town resident located between the two cities would be inclined to shop in one or the other of them according to that resident's position relative to the calculated breaking point. Since the breaking point between cities of unequal size will lie farther from the larger of the two, its spatially greater drawing power is assured (Figure 3.5).

Later studies in location theory, city systems, trade area analysis, and other social topics all suggest that the gravity model can be used to account for a wide variety of flow patterns in human geography, including population migration, commodity flows, journeys to work or to shop, telephone call volumes, and the like. Each such flow pattern suggests that size as well as distance influences spatial interaction. Carey's observation made some 150 years ago initiated a type of analysis that in modified form is used today for a variety of practical studies that help us better understand the "friction of distance."

Interaction Potential

Spatial interaction models of distance decay and gravitational pull deal with only two places at a time. The world of reality is rather more complex. All cities, not just city pairs, within a regional system of cities have the possibility of interacting with each other. Indeed, the more specialized the goods produced in each separate center—that is, the greater their collective complementarity—the more likely it is that such multiple interactions will occur.

A **potential model,** also based on Newtonian physics, provides an estimate of the interaction opportunities available to a center in such a multicentered network. It tells us the relative position of each point in relation to all other places within a region. It does so by summing the size and distance relationships between all points of potential interaction within an area. The concept of potential is applicable whenever the measurement of the intensity of spatial interaction is of concern—as it is in studies of marketing, land values, broadcasting, commuting patterns, and the like.

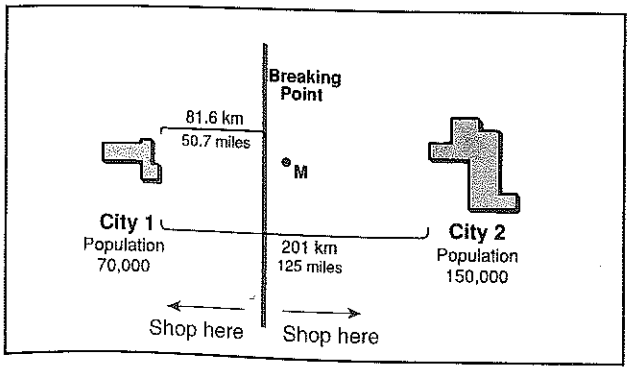


Figure 3.5 The *law of retail gravitation* provides a quick determination of the trade boundary (or breaking point) between two cities. In the diagram, cities 1 and 2 are 201 kilometers (125 mi) apart. Reilly's law tells us that the breaking point between them lies 81.6 kilometers (50.7 mi) distant from City 1. A potential customer located at *M,* midway (100.5 km or 62.5 mi) between the cities, would lie well within the trade zone of City 2. A series of such calculations would define the "trade area" of any single city.

Movement Biases

Distance decay and the gravity and potential models help us understand the bases for interaction in an idealized area without natural or cultural barriers to movement or restrictions on routes followed, and in which only rational interaction decisions are made. Even under those model conditions, the pattern of spatial interaction that develops for whatever reason inevitably affects the conditions under which future interactions will occur. An initial structure of centers and connecting flows will tend to freeze into the landscape a mutually reinforcing continuation of that same pattern. The predictable flows of shoppers to existing shopping centers make those centers attractive to other merchants. New store openings increase customer flow; increased flow strengthens the developed pattern of spatial interaction. And increased road traffic calls for the highway improvement that encourages additional traffic volume.

Such an aggregate regularity of flow is called a **movement bias.** We have already noted a *distance bias* favoring short movements over long ones. There is also *direction bias,* in which of all possible directions of movement, actual flows are restricted to only one or a few. Direction bias is simply a statement that from a given origin, flows are not random (Figure 3.6); rather, certain places have a greater attraction than do others. The movement patterns from an isolated farmstead are likely oriented to a favored shopping town. On a larger scale, in North America or Siberia, long-distance freight movements are directionally biased in favor of east-west flows. Direction bias reflects not just the orientation but also the intensity of flow. Movements from a single point—from Novosibirsk in Siberia, for example, or from Winnipeg, Canada, or Kansas City in the United States—may occur in all directions; they are in reality more intense along the east-west axis.

Such directional biases are in part a reflection of *network bias,* a shorthand way of saying that the presence or absence of connecting channels strongly affects the likelihood that spatial interaction will occur. A set of routes and the set of places that they connect are collectively called a **network.** Flows cannot occur between all points if not all points are linked. In Figure 3.6a, the interchange between *A* and *X,* though not necessarily impossible, is unlikely because the routeway between them is indirect and circuitous. In information flows, a worker on the assembly line is less likely to know of company production plans than is a secretary in the executive offices; these two workers are tied into quite different information networks.

A recognition of movement biases helps to refine the coarser generalizations of spatial interaction based solely on complementarity, transferability, and intervening opportunity. Other modifying statements have been developed, but each further refinement moves us away from aggregate behavior toward less predictable individual movements and responses. The spatial interaction questions we ask and the degree of refinement of the answers we require determine the modifications we must introduce into the models we employ.

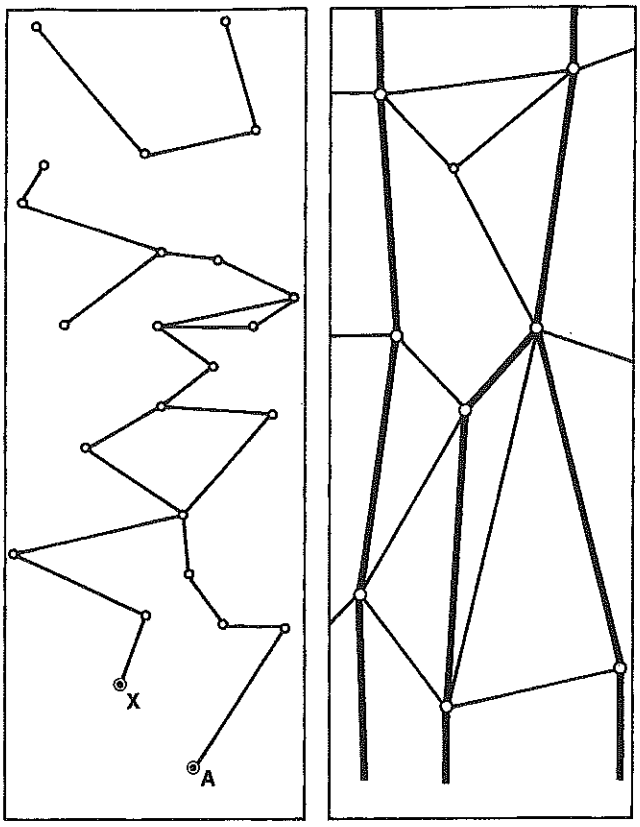


Figure 3.6 Direction bias. (*a*) When direction bias is absent, movements tend to be almost random, occurring in all possible directions, but less likely between points, such as *A* and *X*, not directly connected. (*b*) Direction bias indicating predominantly north-south movements, likely as a result of transportation routes and/or major destinations being aligned north to south.

Human Spatial Behavior

Humans are not commodities and individually do not necessarily respond predictably to the impersonal dictates of spatial interaction constraints. Yet, to survive, people must be mobile and collectively do react to distance, time, and cost considerations of movement in space and to the implications of complementarity, transferability, and intervening opportunity. Indeed, an exciting line of geographic inquiry involves how individuals make spatial behavioral decisions and how those separate decisions may be summarized by models and generalizations to explain collective actions.

Mobility is the general term applied to all types of human territorial movement. Two aspects of that mobility behavior concern us. The first is the daily or temporary use of space—the journeys to stores, to work, or to school, or for longer periods on vacation or college students' relocation between home and school dormitory. These types of mobility are often designated as *circulation* and have no suggestion of relocation of residence (Figure 3.7). The second type of mobility is the longer-term commitment related to decisions to permanently leave the home territory and find residence in a new location. This second form of spatial behavior is termed *migration.*

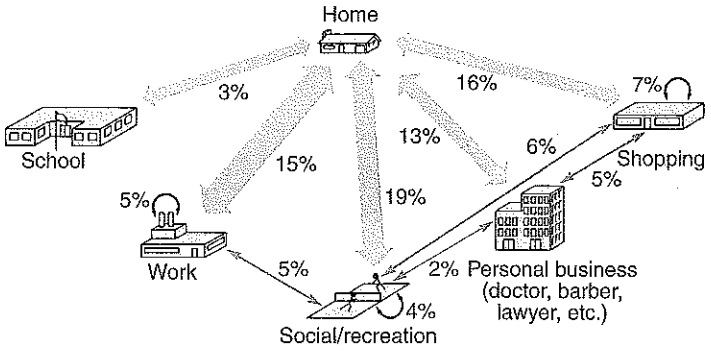


Figure 3.7 Seven County Minneapolis–St. Paul Metropolitan Area travel patterns. The numbers are the percentage of all urban trips taken on a typical weekday. In recent decades the relative importance of work and school trips has decreased while other types of trips have risen in importance.

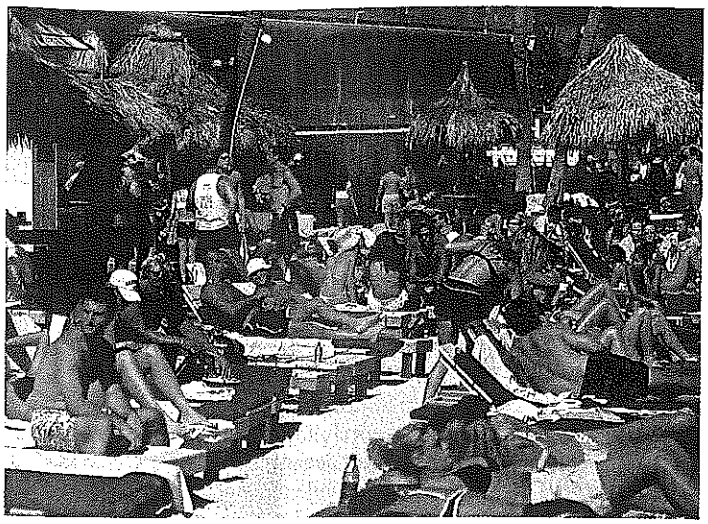
Source: Data from Metropolitan Council: The 2000 Travel Behavior Inventory.

Both aspects imply a time dimension. Humans' spatial actions are not instantaneous. They operate over time, frequently imparting a rhythm to individual and group activity patterns and imposing choices among time-consuming behaviors. Elements of both aspects of human spatial behavior are also embodied in how individuals perceive space and act within it and how they respond to information affecting their space-behavioral decisions. The nature of those perceptions and responses affect us all in our daily movements. The more permanent movement embodied in migration involves additional and less common decisions and behaviors, as we shall see later in this chapter.

Individual Activity Space

One of the realities of life is that groups and countries draw boundaries around themselves and divide space into territories that are, if necessary, defended. Some see the concept of **territoriality**—the emotional attachment to and the defense of home ground—as a root explanation of much of human action and response. It is true that some individual and collective activity appears to be governed by territorial defense responses: the conflict between street groups in claiming and protecting their "turf" (and their fear for their lives when venturing beyond it) and the sometimes violent rejection by ethnic urban neighborhoods of any different advancing population group it considers threatening. On a more individualized basis, each of us claims as **personal space** the zone of privacy and separation from others our culture or our physical circumstances require or permit. Anglo Americans demand greater face-to-face separation in conversations than do Latin Americans. Personal space on a crowded beach or in a department store is acceptably more limited than it is in our homes or when we are studying in a library (Figure 3.8).

For most of us, our personal sense of territoriality is a tempered one. We regard our homes and property as defensible private domains but open them to innocent visitors, known and unknown, or to those on private or official business. Nor do we confine our activities so exclusively within controlled home territories as street-gang members do within theirs. Rather, we have a more or



(a)

(b)

Figure 3.8 Our demanded *personal space* is not necessarily uniform in shape or constant in size. We tolerate strangers closer to our sides than directly in front of us; we accept more crowding in an elevator than in a store. (*a*) We accept the press of the crowd on a popular beach—as do these students on spring break in the Florida Keys (*b*), but tend to distance ourselves from others in a public square.

less extended home range, an **activity space** or area within which we move freely on our rounds of regular activity, sharing that space with others who are also about their daily affairs. Figure 3.9 suggests probable activity spaces for a suburban family of five for a day. Note that the activity space is different and for the mapped day rather limited for each individual, even though two members of the family use automobiles. If one week's activity were shown, more paths would be added to the map, and in a year's time, one or more long trips would probably have to be noted.

The types of trips that individuals make and thus the extent of their activity space depend on at least three interrelated variables: their stage in life course (age); the means of mobility at their command; and the demands or opportunities implicit in their daily activities. The first variable, *stage in life,* refers to membership in specific age groups. School-age children usually travel short distances to lower schools and longer distances to upper-level schools. After-school activities tend to be limited to walking or to bicycle trips to nearby locations. Greater mobility is characteristic of high-school students. Adults responsible for household duties make shopping trips and trips related to child care as well as journeys away from home for social, cultural, or recreational purposes. Wage-earning adults usually travel farther from home than other family members. Elderly people may, through infirmity or interests, have less extensive activity spaces.

The second variable that affects the extent of activity space is *mobility,* or the ability to travel. An informal consideration of the cost and effort required to overcome the friction of distance is implicit. Where incomes are high, automobiles are available, and the cost of fuel is reckoned minor in the family budget, mobility may be great and individual activity space large. In societies or neighborhoods where cars are not a standard means of conveyance, the daily non-emergency activity space may be limited to walking, bicycling, or taking infrequent trips on public transportation. Wealthy suburbanites are far more mobile than are residents of inner-city slums, a circumstance that affects ability to learn about, seek, or retain work and to have access to medical care, educational facilities, and social services.

A third factor limiting activity space is the individual assessment of the existence of possible activities or *opportunities.* In subsistence economies where the needs of daily life are satisfied at home, the impetus for journeys away from home is minimal. If there are no stores, schools, factories, or even roads, expectations and opportunities are limited. Not only are activities spatially restricted, but **awareness space**—knowledge of opportunity locations beyond normal activity space—is minimal, distorted, or absent. In low-income neighborhoods of modern cities in any country, poverty and isolation limit the inducements, opportunities, destinations, and necessity of travel (Figure 1.25). Opportunities plus mobility conditioned by life stage bear heavily on the amount of spatial interaction in which individuals engage.

The Tyranny of Time

The daily activities of humans—eating, sleeping, traveling between home and destination, working or attending classes—all consume time as well as involve space. An individual's spatial reach is restricted because one cannot be in two different places at the same moment or engage simultaneously in activities that are spatially separate. Further, since there is a finite amount of time within a day and each of us is biologically bound to a daily rhythm of day and night, sleeping and eating, time tyrannically limits the spatial choices we can make and the activity space we can command.

Our daily space-time constraints—our *time-geography*—may be represented by a **space-time prism,** the volume of space and length of time within which our activities must be confined. Its size and shape are determined by our mobility; its boundaries define what we can or cannot accomplish spatially or temporally (Figure 3.10). If our circumstances demand that we walk to work or school (Figure 3.10b), the sides of our prism are steep and the space available for our activities is narrow. We cannot use time spent in transit for other activities,

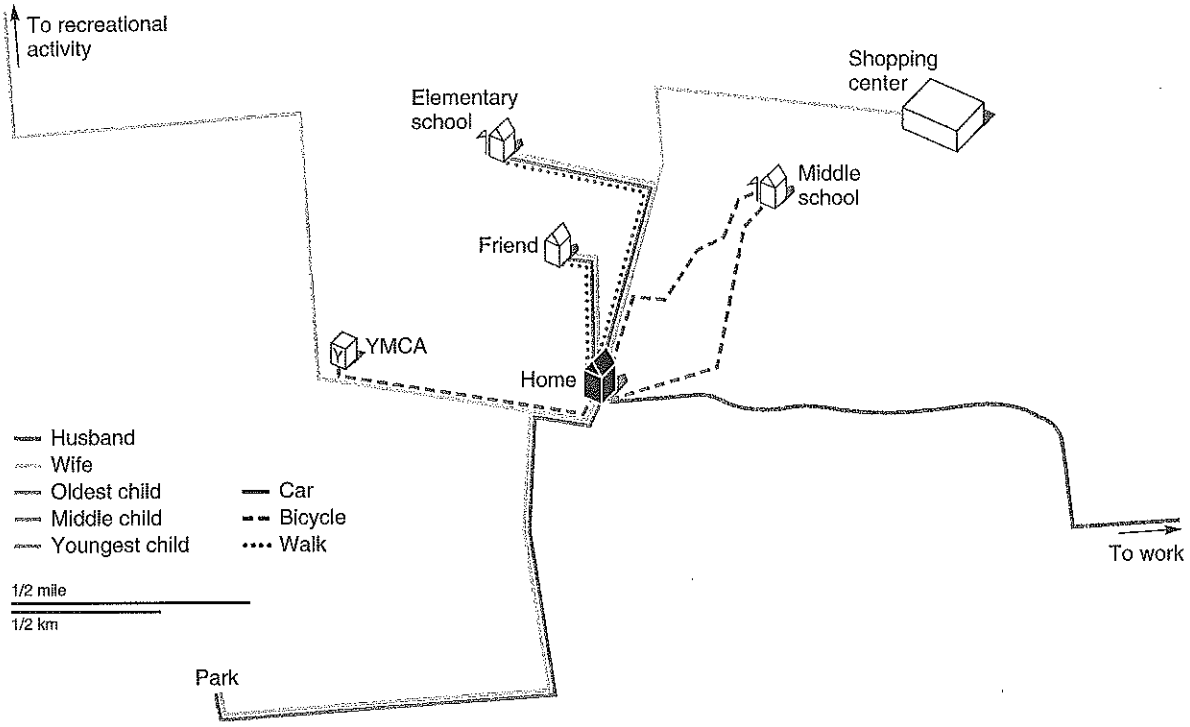


Figure 3.9 Activity space for each member of one author's family of five for a typical weekday. Routes of regular movement and areas recurrently visited help to foster a sense of territoriality and to affect one's perceptions of space.

and the area reasonably accessible to the pedestrian is limited. The space-time prism for the driver (Figure 3.10c) has angled sides and the individual's spatial range is wide. The dimensions of the prism determine what spatially defined activities are possible, for no activity can exceed the bounds of the prism (see "Space, Time, and Women"). Since most activities have their own time constraints, the choices of things you can do and the places you can do them are strictly limited. Defined class hours, travel time from residence to campus, and dining hall location and opening and closing hours, for example, may be the constraints on your *space-time path* (Figure 3.11). If you also need part-time work, your choice of jobs is restricted by their respective locations and work hours, for the job, too, must fit within your daily space-time prism. Parenting responsibilities, particularly for single parents, place major constraints on the spatial range of individuals. In households where one partner (typically the woman) bears greater responsibilities for childcare and household chores, their job choices may be limited by their narrow time-geographic constraints and they may be forced to accept lower pay and/or a less prestigious job.

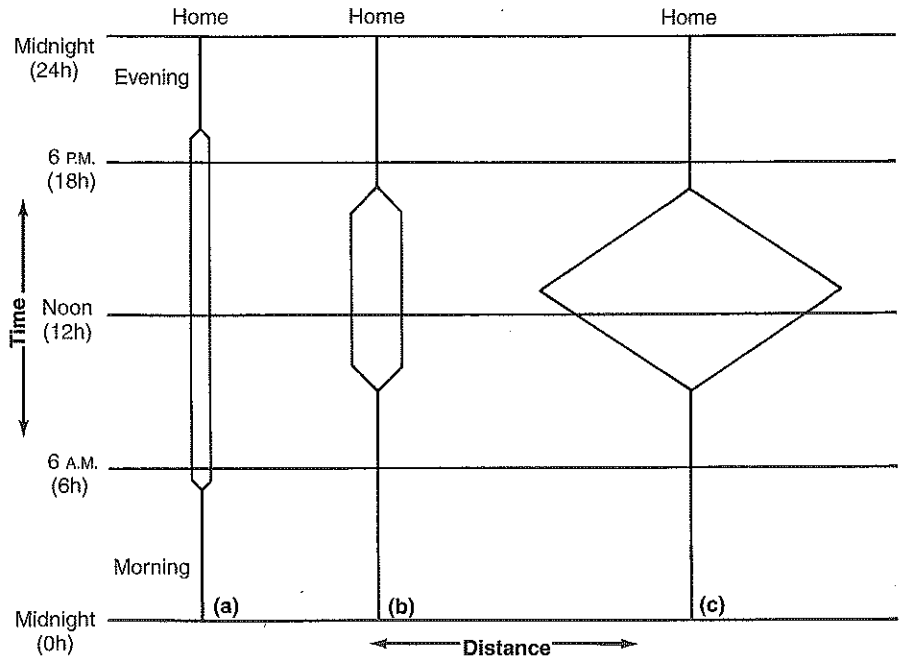
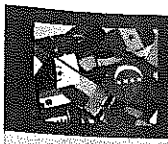


Figure 3.10 The space-time prism. An individual's daily prism has both geographical limits and totally surrounding space-time walls. The *time* (vertical axis) involved in movement affects the space that is accessible, along with the time and space available for other than travel purposes. (*a*) When collecting firewood for household use may take an entire day, as it does in some deforested developing countries, no time or space is left for other activities, and the gatherer's space-time prism may be represented by a straight line. (*b*) Walking to and from work or school and spending the required number of hours there leave little time to broaden one's area of activity. (*c*) The automobile permits an extension of the geographical boundaries of the driver's space-time prism; the range of activity possibilities and locations is expanded for the highly mobile.



Space, Time, and Women

From a time-geographic perspective, it is apparent that many of the limitations women face in their choices of employment or other activities outside the home reflect the restrictions that women's time budgets and travel paths place on their individual daily activities.

Consider the case* of the unmarried working woman with one or more pre-school-age children. The location and operating hours of available child-care facilities may have more of an influence on her choice of job than do her labor skills or the relative merits of alternative employment opportunities. For example, the woman may not be able to leave her home base before a given hour because the only available full-day, child-care service is not open earlier. She must return at the specified child pickup time and arrive home to prepare food at a reasonable (for the child) dinner time. Her travel mode and speed determine the outer limits of her daily space-time prism.

Suppose both of two solid job offers have the same working hours and fall within her possible activity space. She cannot accept the preferred, better paying job because drop-off time at the child-care center would make her late for work, and work hours would make her miss the center's closing time. On the other hand, although the other job is acceptable from a child-care standpoint, it leaves no time (or store options) for shopping or errands except during the lunch break. Job choice and shopping opportunities are thus determined not by the woman's labor skills or awareness of store price comparisons but by her time-geographic constraints. Other women in other job skill, parenthood, locational, or mobility circumstances experience different but comparable space-path restrictions.

Mobility is a key to activity mix, time-budget, and activity space configurations. Again, research indicates that women are frequently disadvantaged. Because of their multiple work, child-care, and home maintenance tasks, women on average make more—though shorter—trips than men, leaving less time for alternate activities.

The lower income level of many single women with or without children limits their ability to own cars and leads them to use public transit disproportionately to their numbers—to the detriment of both their money and time-space budgets. They are, it has been observed, "transportation deprived and transit dependent."

Geographer Mei-Po Kwan used GIS and travel diaries to create three-dimensional diagrams of the time-geography patterns of a sample of men and women who all had driver's licenses and access to automobiles. Despite their relative affluence, Kwan found that women experience more time-geographic constraints than men because of their responsibilities for child-care or school drop-off. Women with other adults in the household to share domestic responsibilities experienced fewer constraints and the women with the most time-geographic constraints were more likely to have to accept part-time work.

*Suggested by Risa Palm and Allan Pred, *A Time-Geographic Perspective on Problems of Inequality for Women.* Institute of Urban and Regional Development, Working Paper no. 236. University of California, Berkeley, 1974.

Source: Mei-Po Kwan, 1999. "Gender, the Home-Work Link, and Space-Time Patterns of Non-Employment Activities, Economic Geography, *75, no. 4 (1999): 370–394.*

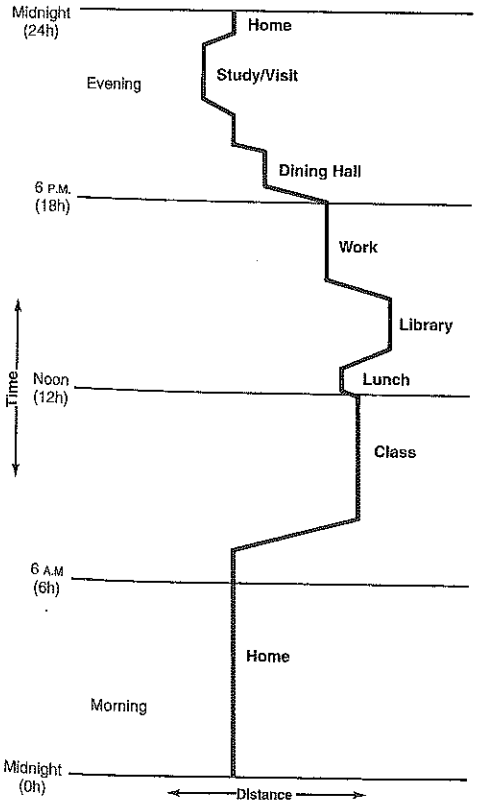


Figure 3.11 School day space-time path for a hypothetical college student.

Distance and Human Interaction

People make many more short-distance trips than long ones, a statement in human behavioral terms of the concept of *distance decay.* If we drew a boundary line around our activity space, it would be evident that trips to the boundary are taken much less often than short-distance trips around the home. The tendency is for the frequency of trips to fall off very rapidly beyond an individual's **critical distance**—the distance beyond which cost, effort, and means strongly influence our willingness to travel. Figure 3.12 illustrates the point with regard to journeys from the homesite.

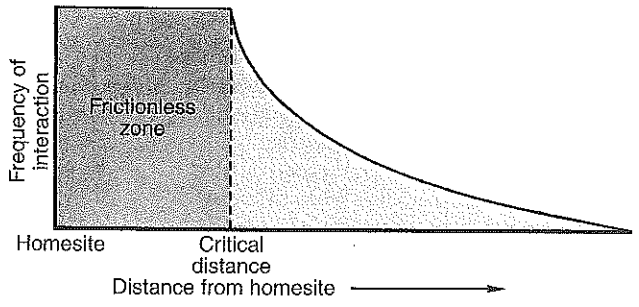


Figure 3.12 Critical distance. This general diagram indicates how most people observe distance. For each activity, there is a distance beyond which the intensity of contact declines. This is called the *critical distance.* The distance up to the critical distance is identified as a *frictionless zone,* in which time or distance considerations do not effectively figure in the trip decision.

Regular movements defining our individual activity space are undertaken for different purposes and are differently influenced by time and distance considerations. The kinds of activities individuals engage in can be classified according to type of trip: journeys to work, to school, to shop, for recreation, and so on. People in nearly all parts of the world make these same types of journeys, though the spatially variable requirements of culture, economy, and personal circumstance dictate their frequency, duration, and significance to an individual (Figure 3.13). A small child, for example, will make many trips up and down the block but is inhibited by parental admonitions from crossing the street. Different but equally effective distance constraints control adult behavior.

The journey to work plays a decisive role in defining the activity space of most adults. Formerly restricted by walking distance or by the routes and schedules of mass transit systems, the critical distances of work trips have steadily increased in European and Anglo American cities as the private automobile figures more importantly in the movement of workers (Figure 3.14). Daily or weekly shopping may be within the critical distance of an individual, and little thought may be given to the cost or the effort involved. That same individual, however, may relegate shopping for special goods to infrequent trips and carefully consider their cost and effort. The majority of our social contacts tend to be at short distance within our own neighborhoods or with friends who live relatively close at hand; longer social trips to visit relatives are less frequent. In all such trips, however, the distance decay function is clearly at work (Figure 3.15).

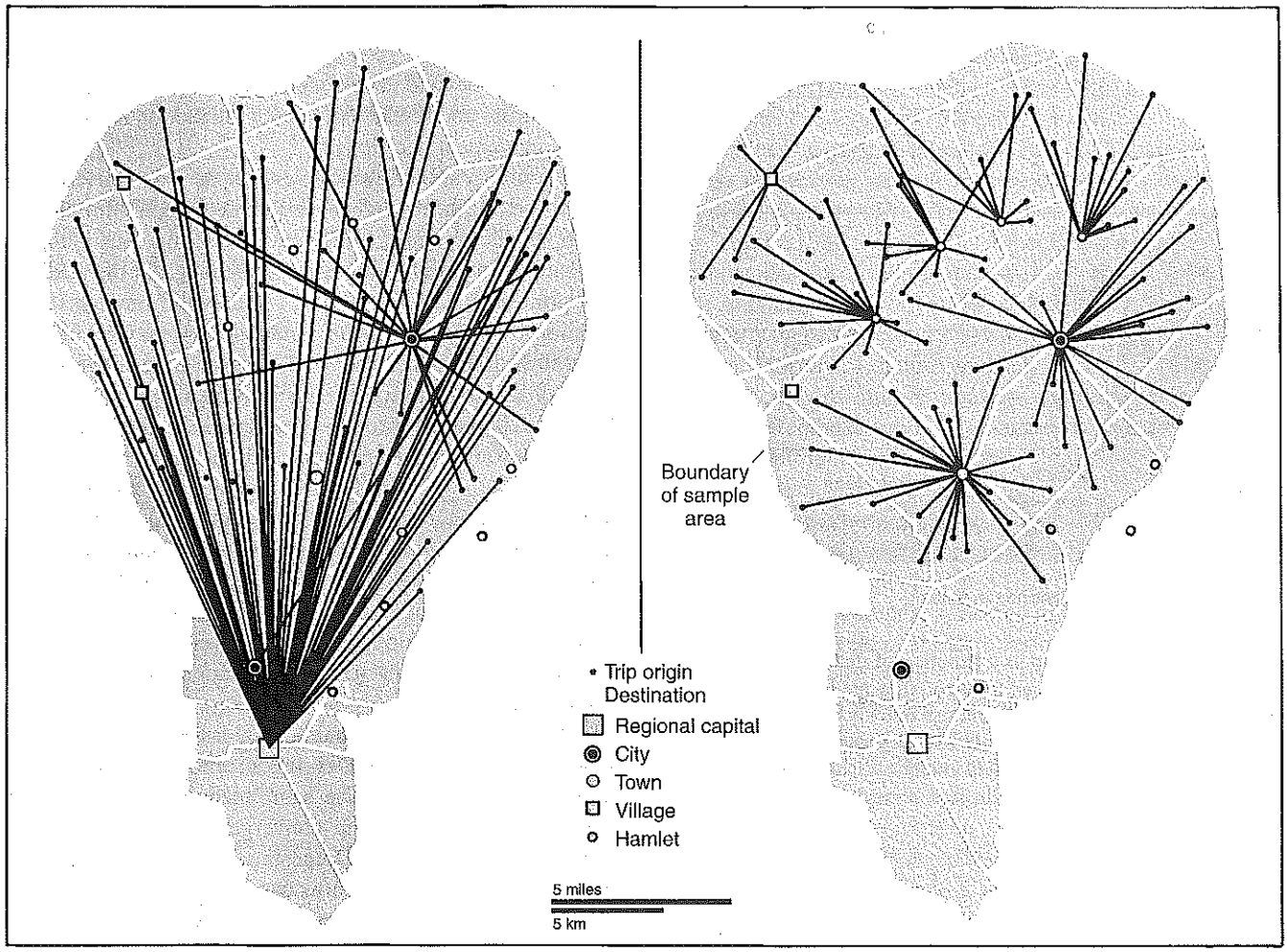


Figure 3.13 **Travel patterns for purchases of clothing and yard goods** of (*a*) rural cash-economy Canadians and (*b*) Canadians of the Old Order Mennonite sect. These strikingly different travel behaviors mapped many years ago in central Canada demonstrate the great differences that may exist in the action spaces of different culture groups occupying the same territory. At that time, "modern" rural Canadians, owning cars and wishing to take advantage of the variety of goods offered in the more distant regional capital, were willing and able to travel longer distances than were neighboring people of a traditionalist culture who had different mobility and whose different demands in clothing and other consumer goods were, by preference or necessity, satisfied in nearby small settlements. Unpublished studies suggest that similar contrasts in mobility and purchase travel patterns currently exist between buggy-using Old Order Amish (see Figure 7.2) and their car-driving neighbors.

Source: Robert A. Murdie, "Cultural Differences in Consumer Travel," Economic Geography *41, no. 3 (Worcester, Mass.: Clark University, 1965). Redrawn by permission.*

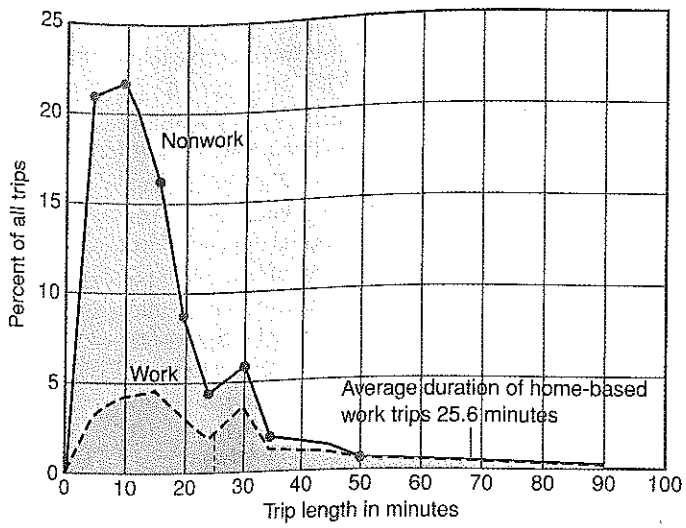


Figure 3.14 The frequency distribution of work and nonwork trip lengths in minutes in the seven-county Minneapolis–St. Paul Metropolitan Area. Studies in various metropolitan areas support the conclusions documented by this graph: work trips are usually longer than other recurring journeys. In the United States in the early 1990s, the average work trip covered 17.1 kilometers (10.6 mi), and half of all trips to work took under 22 minutes; for suburbanites commuting to the central business district, the journey to work involved between 30 and 45 minutes. By 2000, increasing sprawl had lengthened average commuting distances and, because of growing traffic congestion, had increased the average work trip commuting time to 25 minutes; many workers had commutes of more than 45 minutes.

Source: Metropolitan Council: The 2000 Travel Behavior Inventory.

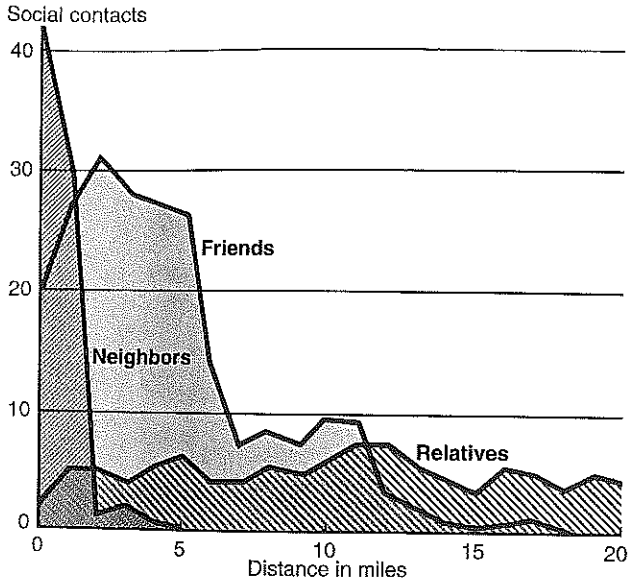


Figure 3.15 Social interaction as a function of distance. Visits with neighbors on the same street are frequent; they are less common with neighbors around the corner and diminish quickly to the vanishing point after a residential relocation. Friends exert a greater spatial pull, though the distance decay factor is clearly evident. Visits with relatives offer the greatest incentive for longer distance (though relatively infrequent) journeys.

Source: Frederick P. Stutz, "Distance and Network Effects on Urban Social Travel Fields," Economic Geography 49, no. 2 (Worcester, Mass.: Clark University, 1973), p. 139. Redrawn by permission.

Spatial Interaction and the Accumulation of Information

Critical distances, even for the same activity, are different for each person. The variables of life stage, mobility, and opportunity, together with an individual's interests and demands, help define how often and how far a person will travel. On the basis of these variables, we can make inferences about the amount of information a person is likely to acquire about his or her activity space and the area beyond. The accumulation of information about the opportunities and rewards of spatial interaction helps increase and justify movement decisions.

For information flows, however, space has a different meaning than it does for the movement of commodities. Communication, for example, does not necessarily imply the time-consuming physical relocations of freight transportation (though in the case of letters and print media it usually does). Indeed, in modern telecommunications, the process of information flow may be instantaneous regardless of distance. The result is space-time convergence to the point of the obliteration of space. A Bell System report tells us that in 1920, putting through a transcontinental telephone call took 14 minutes and eight operators and cost more than $15.00 for a 3-minute call. By 1940, the call completion time was reduced to less than 1½ minutes, and the cost fell to $4.00. In the 1960s, direct distance dialing allowed a transcontinental connection in less than 30 seconds, and electronic switching has now reduced the completion time to that involved in dialing a number and answering a phone. The price of long-distance conversation essentially disappeared with the advent of voice communication over the Internet early in this century.

The Internet and communication satellites have made worldwide personal and mass communication immediate and data transfers instantaneous. The same technologies that have led to communication space-time convergence have tended toward a space-cost convergence. Domestic mail, which once charged a distance-based postage, is now carried nationwide or across town for the same price. In the modern world, transferability is no longer a consideration in information flows.

A speculative view of the future suggests that as distance ceases to be a determinant of the cost or speed of communication, the spatial structure of economic and social decision making may be fundamentally altered. Determinations about where people live and work, the role of cities and other existing command centers, flows of domestic and international trade, constraints on human mobility, and even the concepts and impacts of national boundaries may fundamentally change with new and unanticipated consequences for patterns of spatial interaction.

Information Flows

Spatially significant information flows are of two types: individual (person-to-person) exchanges and mass (source-to-area) communication. A further subdivision into formal and informal interchange recognizes, in the former, the need for an interposed channel (radio, press, postal service, or telephone, for example) to convey messages. Informal communication requires no such institutionalized message carrier.

Short-range informal *individual communication* is as old as humankind itself. Contacts and exchanges between individuals and within small groups tend to increase as the complexity of social organization increases, as the size and importance of the population center grow, and as the range of interests and associations of the communicating person expands. Each individual develops a **personal communication field,** the informational counterpart of that person's activity space. Its size and shape are defined by the individual's contacts in work, recreation, shopping, school, or other regular activities. Those activities, as we have seen, are functions of the age, sex, education, employment, income, and so on of each person. An idealized personal communication field is suggested in Figure 3.16.

Each interpersonal exchange constitutes a link in the individual's personal communication field. Each person, in turn, is a node in the communication field of those with whom he or she makes or maintains contact. The total number of such separate informal networks equals the total count of people alive. Despite the number of those networks, all people, in theory, are interconnected by multiple shared nodes (Figure 3.17). One debated experiment suggested that through such interconnections no person in the United States is more than six links removed from any other person, no matter where located or how unlikely the association.

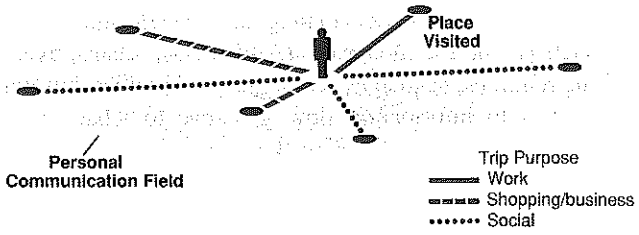


Figure 3.16 **A personal communication field** is determined by individual spatial patterns of communication related to work, shopping, business trips, social visits, and so on.

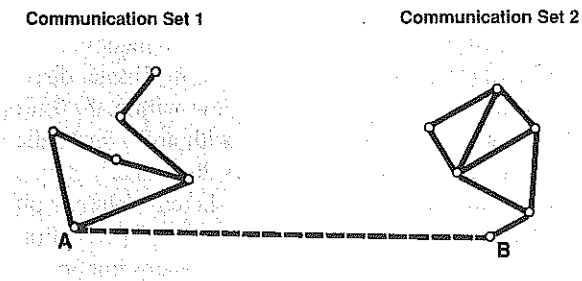


Figure 3.17 Separate population sets (groups) are interconnected by the links between individuals. If link A–B exists, everyone in the two sets is linked.

Mass communication is the formal, structured transmission of information in essentially a one-way flow between single points of origin and broad areas of reception. There are few transmitters and many receivers. The mass media are by nature "space filling." From single origin points, they address their messages by print, radio, or television to potential receivers within a defined area. The number and location of disseminating points, therefore, are related to their spatial coverage characteristics, to the minimum size of area and population necessary for their support, and to the capability of the potential audiences to receive their message. The coverage area is determined both by the nature of the medium and by the corporate intent of the agency.

There are no inherent spatial restrictions on the dissemination of printed materials, though of course limitations and restrictions may be imposed by obscenity laws, religious prohibitions (throughout the Islamic world and parts of the Catholic world), restrictions in some countries on certain forms of political speech, and the like. And not everyone has access to bookstores or libraries or funds to buy printed material, and not everyone can read. Unlike the distance limitations on the transmission of AM or FM radio waves, however, these restrictions are independent of the area over which printed material could be physically distributed and made available.

In the United States, much book and national magazine publishing has localized in metropolitan New York City, as have the services supplying news and features for sale to the print media located there and elsewhere in the country. Paris, Buenos Aires, Moscow, London—indeed, the major metropolises and/or capital cities of other countries—show the same spatial concentration. Regional journals emanate from regional capitals, and major metropolitan newspapers, though serving primarily their home markets, are distributed over (or produce special editions for distribution within) tributary areas whose size and shape depend on the intensity of competition from other metropolises. A spatial information hierarchy has thus emerged.

Hierarchies are also reflected in the market-size requirements for different levels of media offerings. National and international organizations are required to expedite information flows (and, perhaps, to control their content), but market demand is heavily weighted in favor of regional and local coverage. In the electronic media, the result has been national networks with local affiliates acting as the gatekeepers of network offerings and adding to them locally originating programs and news content. A similar market subdivision is represented by the regional editions of national newspapers and magazines.

The technological ability to fill space with messages from different mass media is unavailing if receiving audiences do not exist. In illiterate societies, publications cannot inform or influence. Unless the appropriate receivers are widely available, television and radio broadcasts are a waste of resources. Perhaps no invention in history has done more to weld isolated individuals and purely person-to-person communicators into national societies exposed to centralized information flows than has the low-cost transistor radio. Its battery-powered transportability converts the remotest village and the most isolated individual into a receiving node of entertainment, information, and political messages. The direct

satellite broadcast of television programs to community antennae or communal sets brings that mass medium to remote areas of Arctic Canada, India, Indonesia, and other world areas able to invest in the technology but as yet unserved by ground stations.

Information and Perception

Human spatial interaction, as we have seen, is conditioned by a number of factors. Complementarity, transferability, and intervening opportunities help pattern the movement of commodities and peoples. Flows between points and over area are influenced by distance decay and partially explained by gravity and potential models. Individuals in their daily affairs operate in activity spaces that are partly determined by stage in life, mobility, and a variety of socioeconomic characteristics. In every instance of spatial interaction, however, decisions are based on information about opportunity or feasibility of movement, exchange, or want satisfaction.

More precisely, actions and decisions are based on **place perception**—the awareness we have, as individuals, of home and distant places and the beliefs we hold about them. Place perception involves our feelings and understandings, reasoned or irrational, about the natural and cultural characteristics of an area and about its opportunity structure. Whether our view accords with that of others or truly reflects the "real" world seen in abstract descriptive terms is not the major concern. Our perceptions are the important thing, for the decisions people make about the use of their lives or about their actions in space are based not necessarily on reality but on their assumptions and impressions of reality.

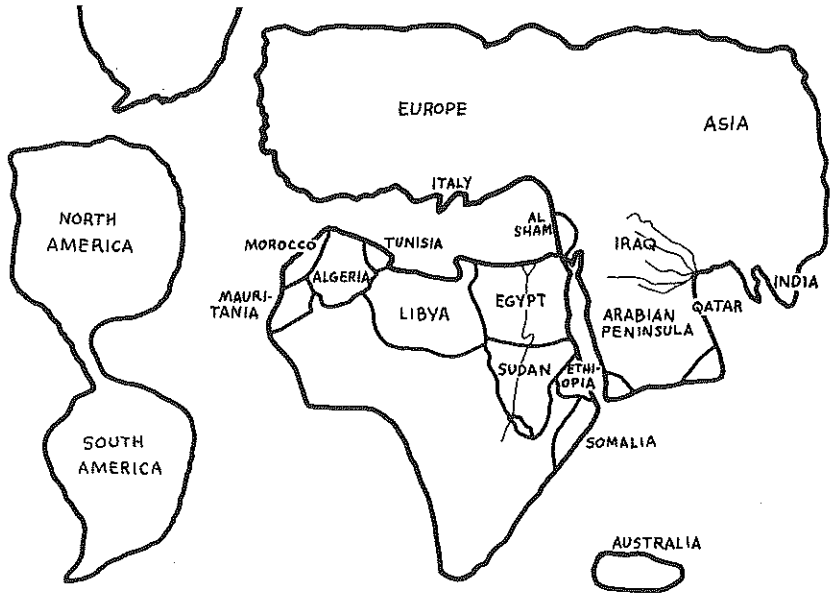


Figure 3.18 A Palestinian student's view of the world. The map was drawn by a Palestinian high-school student from Gaza. The map reflects the instruction and classroom impressions the student has received. The Gaza curriculum conforms to the Egyptian national standards and thus is influenced by the importance of the Nile River and pan-Arabism. Al Sham is the old, but still used, name for the area including Syria, Lebanon, and Palestine. The map might be quite different in emphasis if the Gaza school curriculum were designed by Palestinians or if it had been drawn by an Israeli student.

Perception of Environment

Psychologists and geographers are interested in determining how we arrive at our perceptions of place and environment both within and beyond our normal activity space. The images we form firsthand of our home territory have been in part reviewed in the discussion of mental maps in Chapter 1. The perceptions we have of more distant places are less directly derived (Figure 3.18). In technologically advanced societies, television and radio, magazines and newspapers, books and lectures, travel brochures and hearsay all combine to help us develop a mental picture of unfamiliar places and of the interaction opportunities they may contain. Again, however, the most effectively transmitted information seems to come from word-of-mouth reports. These may be in the form of letters or visits from relatives, friends, and associates who supply information that helps us develop lines of attachment to relatively unknown areas.

There are, of course, barriers to the flow of information, including that of distance decay. Our knowledge of close places is greater than our knowledge of distant points; our contacts with nearby persons theoretically yield more information than we receive from afar. Yet in crowded areas with maximum interaction potential, people commonly set psychological barriers around themselves so that only a limited number of those possible interactions and information exchanges actually occur. We raise barriers against information overload and to preserve a sense of privacy that permits the filtering out of information that does not directly affect us. There are obvious barriers to long-distance information flows as well, such as time and money costs, mountains, oceans, rivers, and differing religions, languages, ideologies, and political systems.

Barriers to information flow give rise to what we earlier (p. 70) called *direction bias*. In the present usage, this implies a tendency to have greater knowledge of places in some directions than in others. Not having friends or relatives in one part of a country may represent a barrier to individuals, so interest in and knowledge of the area beyond the "unknown" region are low. In the United States, both northerners and southerners tend to be less well informed about each other's areas than about the western part of the country. Traditional communication lines in the United States follow an east-west rather than a north-south direction, the result of early migration patterns, business connections, and the pattern of the development of major cities. In Russia, directional bias favors a north-south information flow within the European part of the country and less familiarity with areas far to the east. Within Siberia, however, east-west flows dominate.

When information about a place is sketchy, blurred pictures develop. These influence the impression—the perception—we have of places and cannot be discounted. Many important decisions are made on the basis of incomplete information or biased reports, such as decisions to visit or not, to migrate or not, to hate or not, even to make war or not. Awareness of places is usually accompanied by opinions about them, but there is no necessary

relationship between the depth of knowledge and the perceptions held. In general, the more familiar we are with a locale, the more sound the factual basis of our mental image of it will be. But individuals form firm impressions of places totally unknown to them personally, and these may color interaction decisions.

One way to determine how individuals envisage home or distant places is to ask them what they think of different locales. For instance, they may be asked to rate places according to desirability—perhaps residential desirability—or to make a list of the 10 best and the 10 worst cities in their country of residence. Certain regularities appear in such inquiries. Figure 3.19 presents some residential desirability data elicited from college students in three provinces of Canada. These and comparable mental maps derived from studies conducted by researchers in many countries suggest that near places are preferred to far places unless much information is available about the far places. Places of similar culture are favored, as are places with high standards of living. Individuals tend to be indifferent to unfamiliar places and areas and to dislike those that have competing interests (such as distasteful political and military activities or conflicting economic concerns) or a physical environment perceived to be unpleasant.

On the other hand, places perceived to have superior climates or landscape amenities are rated highly in mental map studies and favored in tourism and migration decisions. Holiday tours to Spain, the south of France, and the Mediterranean islands are heavily booked by the British seeking to escape their damp, cloudy climate. A U.S. Census Bureau study indicates that "climate" is, after work and family proximity, the most often reported reason for interstate moves by adults of all ages. International studies reveal a similar migration motivation based not only on climate but also on concepts of natural beauty and amenities.

Perception of Natural Hazards

Less certain is the negative impact on spatial interaction or relocation decisions of assessments of *natural hazards.* Natural hazards are elements, processes, or events in the environment that can cause

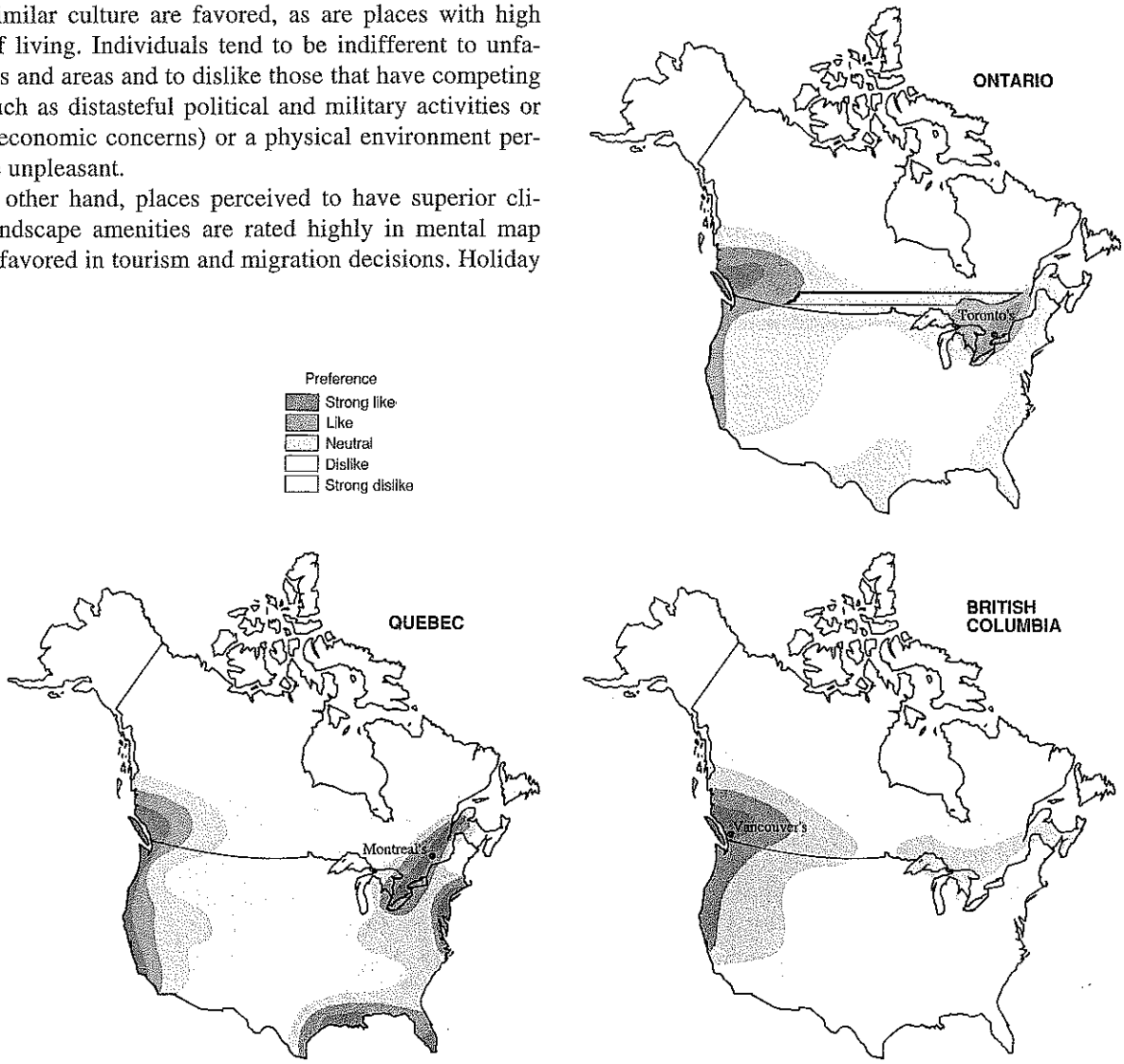


Figure 3.19 Residential preferences of Canadians. These maps show the residential preference of a sampled group of Canadians from the Provinces of British Columbia, Ontario, and Quebec, respectively. Note that each group of respondents prefers its own area, but all like the Canadian and U.S. west coasts.

Source: Herbert A. Whitney, "Preferred Locations in North America: Canadians, Clues, and Conjectures," Journal of Geography *83, no. 5, p. 222. (Indiana, Pa.: National Council for Geographic Education, 1984). Redrawn by permission.*

harm to humans. While the term implies that these hazards are "natural," human adaptation and location decisions play a major role in determining how disastrous the results are.

Mental images of home areas do not generally include as an overriding concern an acknowledgment of potential natural dangers. The cyclone that struck the delta area of Bangladesh on November 12, 1970, left at least 500,000 people dead, yet after the disaster the movement of people into the area swelled population above precyclone levels—a resettlement repeated after other, more recent cyclones. The July 28, 1976, earthquake in the Tangshan area of China devastated a major urban industrial complex, with casualties estimated at about a quarter-million, and between 50,000 and 100,000 city dwellers and villagers reportedly perished during and after the January, 2001, quake in Gujarat state of western India. In both cases, rebuilding began almost immediately, as it usually does following earthquake damage (Figure 3.20) or after the devastation of earthquake-induced tsunamis like the December, 2004, inundation of the Indonesian, Thai, and Indian coasts. The human response to even such major and exceptional natural hazards is duplicated by a general tendency to discount dangers from more common hazard occurrences. Johnstown, Pennsylvania, has suffered recurrent floods, and yet its residents rebuild; violent storms like Hurricane Katrina recurrently strike the Gulf and East coasts of the United States (Figure 3.21), and people remain or return. Californians may be concerned about Kansas tornadoes if contemplating a move there but be unconcerned about earthquake dangers at home.

Why do people choose to settle in areas of high-consequence hazards in spite of the potential threat to their lives and property? Why do hundreds of thousands of people live along the San Andreas Fault in California, build houses in Pacific coastal areas known to experience severe erosion during storms, return to flood-prone river valleys in Europe or Asia, or avalanche-threatened Andean valleys? What is it that makes the risk worth taking? Ignorance of natural hazard danger is not necessarily a consideration. People in seismically active regions of the United States and Europe, at least, do believe that damaging earthquakes are a possibility in their districts but, research indicates, are reluctant to do anything about the risk. Similar awareness and reticence accompanies other low-incidence/high-consequence natural dangers. Less than one-tenth of 1% of respondents to a federal survey gave "natural disaster" as the reason for their interstate residential move.

There are many reasons why natural hazard risk does not deter settlement or adversely affect space-behavioral decisions. Of importance, of course, is the persistent belief that the likelihood of an earthquake or a flood or other natural calamity is sufficiently remote so that it is not reasonable or pressing to modify behavior because of it. People are influenced by their innate optimism and the predictive uncertainty about timing or severity of

Figure 3.20 Destruction from the San Francisco earthquake and fire. The first shock struck San Francisco early on the morning of April 18, 1906, damaging the city's water system. Fire broke out and raged for three days. It was finally stopped by dynamiting buildings in its path. When it was over, some 700 people were dead or missing, and 25,000 buildings had been destroyed. Locally, the event is usually referred to as the Great Fire of 1906, suggesting a denial of the natural hazard in favor of assigning blame to correctable human error. Post-destruction reconstruction began at once. Rebuilding following earthquake damage is the general rule.

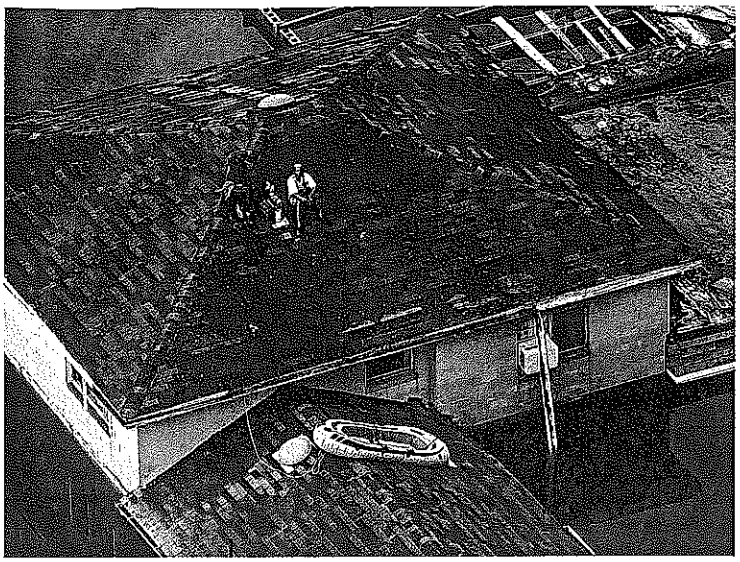


Figure 3.21 People waiting to be rescued from a New Orleans rooftop following Hurricane Katrina's assault in late August, 2005. More than 1600 died, hundreds of thousands were left homeless, and tens of billions of dollars of damage were incurred from the storm, which was immediately followed by government and private efforts at recovery and rebuilding.

a calamitous event and by their past experiences in high-hazard areas. If they have not suffered much damage in the past, they may be optimistic about the future. If, on the other hand, past damage has been great, they may think that the probability of repetition in the future is low (Table 3.1).

Perception of place as attractive or desirable may be quite divorced from any understanding of its hazard potential. Attachment to locale or region may be an expression of emotion and economic or cultural attraction, not just a rational assessment of risk. The culture hearths of antiquity discussed in Chapter 2 and shown on Figure 2.15 were for the most part sited in flood-prone river valleys; their enduring attraction was undiminished by that potential danger. The home area, whatever disadvantages an outside observer may discern, exerts a force not easily dismissed or ignored.

Indeed, high-hazard areas are often sought out because they possess desirable topography or scenic views, as do, for instance, coastal areas subject to storm damage. Once people have purchased property in a known hazard area, they may be unable to sell it for a reasonable price even if they so desire. They think that they have no choice but to remain and protect their investment. The cultural hazard—loss of livelihood and investment—appears more serious than whatever natural hazards there may be.

Carried further, it has been observed that spatial adjustment to perceived natural hazards is a luxury not affordable to impoverished people in general or to the urban and rural poor of Third World countries in particular. Forced by population growth and economic necessity to exert ever-greater pressures upon fragile environments or to occupy at higher densities hazardous hillside and floodplain slums, their margin of safety in the face of both chronic and low-probability hazards is minimal to nonexistent (Figure 3.22).

Table 3.1

Common Responses to the Uncertainty of Natural Hazards

Eliminate the Hazard	
Deny or Denigrate Its Existence	**Deny or Denigrate Its Recurrence**
"We have no floods here, only high water."	"Lightning never strikes twice in the same place."
"It can't happen here."	"It's a freak of nature."
Eliminate the Uncertainty	
Make It Determinate and Knowable	**Transfer Uncertainty to a Higher Power**
"Seven years of great plenty. . . . After them seven years of famine."	"It's in the hands of God."
"Floods come every five years."	"The government is taking care of it."

Source: Burton and Kates, "The Perception of Natural Hazards in Resource Management," 3 *Natural Resources Journal* 435 (1964). Used by permission of the University of New Mexico School of Law, Albuquerque, N.M.

STOP

Migration

When continental glaciers began their retreat some 11,000 years ago, the activity space and awareness space of Stone Age humans were limited. As a result of pressures of numbers, need for food, changes in climate, and other inducements, those spaces were collectively enlarged to encompass the world. **Migration**—the permanent or planned long-term relocation of residential place and activity space—has been one of the enduring themes of human history. It has contributed to the evolution of separate cultures, to the diffusion of those cultures and their components by interchange and communication, and to the frequently complex mix of peoples and cultures found in different areas of the world. Indeed, it has been a major force in shaping the world as it is today.

Massive movements of people within countries, across national borders, and between continents have emerged as a pressing concern of recent decades. They affect national economic structures, determine population density and distribution patterns, alter traditional ethnic, linguistic, and religious mixtures, and inflame national debates and international tensions. Because migration patterns and conflicts touch so many aspects of social and economic relations and have become so important a part of current human geographic realities, their specific impact is a significant aspect of several of our topical concerns. Portions of the story of migration have been touched on already in Chapter 2; other elements of it are part of later discussions of population (Chapter 4), ethnicity (Chapter 6), economic development (Chapter 10), urbanization