The Journal of Geography

VOL. 72 MAY, 1973 NUMBER 5

MEASURING HUMAN EXTENSIBILITY IN A SHRINKING WORLD

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ABSTRACT. The concepts of time-space convergence and human extensibility provide important insights relating the impacts of transportation and communications advances with the human organization of space. This paper explains these concepts and suggests how they may be used for structuring classroom projects.

The significance of transport and communications innovations and their pronounced spatial implications requires that they receive emphasis in classroom curriculums at all levels. Particular attention must be directed toward developing skills in measurement. For example, unless we can measure the degrees to which transportation and communication innovations facilitate speedier, safer and more convenient movement of people, goods, raw materials and information, we have little hope of channeling their broader societal impacts in desirable directions.

Although it is generally accepted that recent transportation and communications advances have brought places on the earth's surface dramatically closer to one another in time-distance, it is, perhaps, more to the point to focus attention on the increasing opportunities of human beings to extend their physical presence and mental force over larger areas of earth-space. *Time-space convergence* and *human extensibility* are related concepts which help characterize the impacts of transport and communication innovations. Whereas time-space convergence[1] is a measure of the degree to which places are approaching one another in time-distance, human extensibility measures the increased opportunities for interaction among people and places.

This paper presents examples of the convergence and extensibility processes, discuss procedures for measuring associated changes resulting from transport and communications innovations, relates the implications of these concepts to broad social, economic and political issues and suggests their utility for structuring classroom projects.

Time-space Convergence

Truly revolutionary advances in transportation and communications have forced us to abandon absolute conceptions on the significance of distance. Whereas the 85 miles separating Lansing

[1]The concept of *time-space convergence* is developed in Donald G. Janelle, "Central Place Development in a Time-space Framework", *The Professional Geographer* XX (Jan., 1968), pp. 5-10.

and Detroit, Michigan required approximately 1,275 minutes to travel via stage coach in 1840, the same trip takes only 78 minutes today by automobile. The significance of this 85 miles has declined an average of nine minutes per year since 1840. For transfers of information, world-wide systems for tele-satellite communications bring these and other places on the earth's surface only fractions of a second apart. And, already, while plans for ground-travel speeds in excess of 500 miles per hour are on the drawing boards, intercontinental missiles have dramatized the significance of a "thirty minute world."

These advances however contrast sharply with the significance of transportation changes at intra-urban levels. Speeds of four to ten miles per hour were possible via horse-drawn vehicles in the 1840's. Yet the average peak hour speeds of automobiles in the central business districts of major North American cities through the early 1960's varied between seven and twelve miles per hour. Some cities improved their speed records with central city freeways — but these gains were at the expense of other unforeseen problems such as inadequate parking, the uprooting of households and the division of spatially coherent communities. To a large extent however, the substitution of communications for transportation has offset what might have been an even more blatant mutilation of the urban social fabric.

Thus we discover that, whereas the world as viewed from the regional and global scales is indeed shrinking, at the local scale functional distances, as measured by the expense of money or time, are either increasing or they are decreasing very slowly. The concepts of time-space convergence and time-space divergence have been suggested as tools for measuring the degree of transport innovation in terms of associated changes in travel-time.[2] As shown in Figure 1, places may actually approach one another in the realm of time-space as transport improvements reduce the significance of distance. Between 1860 and 1960 Moscow and Leningrad converged upon one another at the average rate of 8.35 minutes per year as a consequence of improved passenger rail service. This simple convergence rate glosses over the true complexity of the convergence process. The remarkable shift in the relative locations of these two cities was the product of a complex intermixing of decision making admidst changing social, economical, political and technological forces. To say that Moscow and Leningrad have converged upon one another at 8.35 minutes per year is to summarize the technological consequence of a considerable history. It is this very simplicity, however, which makes the convergence concept so appealing — it provides for comparable measures of transport change among a variety of places and it is responsive to historical events. For example, Figure 1 illustrates the time-space divergence or deterioration of transport service between these places in response to the events of the Revolution and the two World Wars.

Time-space convergence/divergence is similar to the concept of velocity; it provides a functional and dynamic interpretation to the concept of distance by focusing attention on the rates (speeds) at which places move towards or away from one another. In accordance with this notion of distance, settlement patterns are in a continual state of relative locational flux as a consequence of transport improvements and deterioration. Divergence, as illustrated by declining average speeds in many central business areas, appears to represent only a temporary lag in the overall and apparently inevitable process of convergence. The quest for accessibility is

[2]See Donald G. Janelle, "Spatial Reorganization: A Model and Concept", *Annals*, The Association of American Geographers, 59 (June, 1969), pp. 348-364.

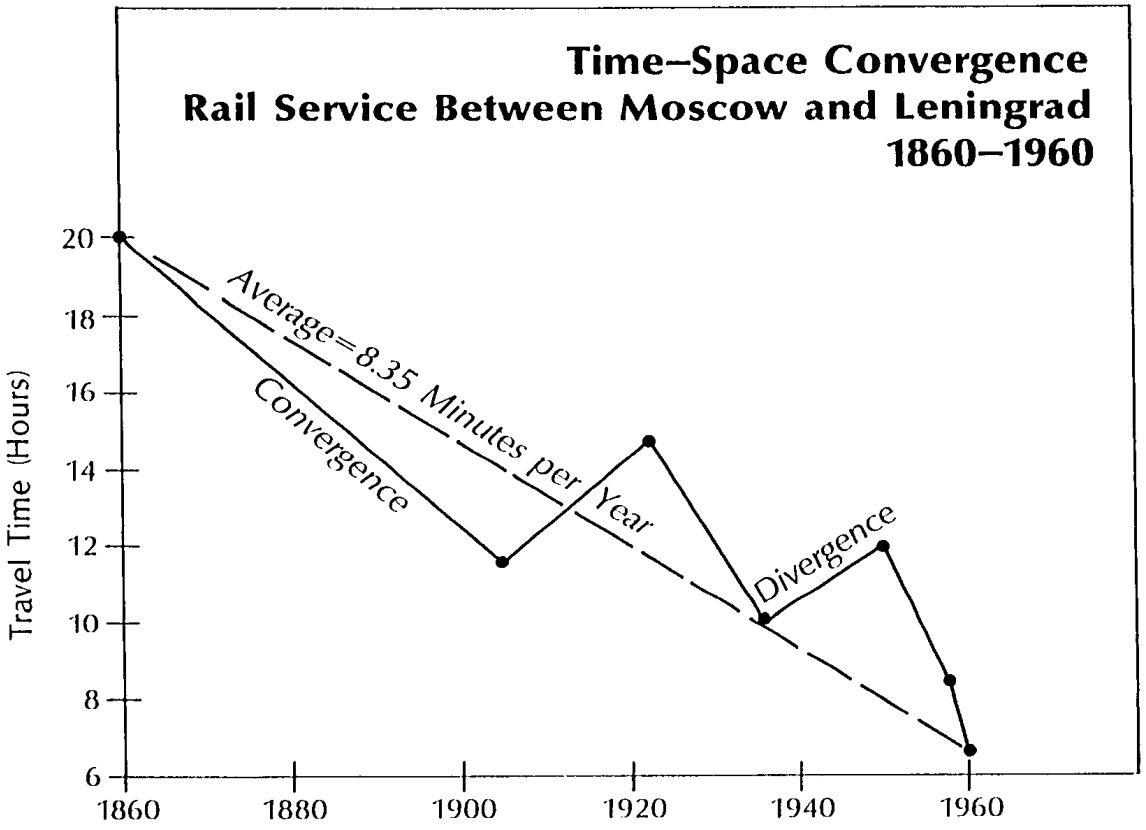

FIGURE 1

an unmistaken human drive, the motivations for which, whether they be adventure, wealth, political control or sociability factors, are not completely known.

As innovations in transportation and communications transform the geographical situations of our institutions, locational and operational adjustments must be made. For instance, in the face of a shrinking world, the institutional structures of trade, tourism, politics and war have responded with trends towards more regionally and globally defined organizations and flow patterns. In their turn, telephones, transistor radios, televisions, video phones, cables and communication satellites are also having profound effects on the patterns of human spatial organization. As an ultimate, Constantinos Doxiadis considers it essential that all major settlements on earth be accessible to one another within ten minutes of travel time.[3] This is equivalent to 120 times the travel speed of present conventional jet passenger planes and four times the speed of current intercontinental missiles. What new patterns of spatial organization would be necessitated by such shifts?

Against the backdrop of glib forecasts about the emergent utopia, it is easy to trap ourselves into the belief that all men benefit equally from transport and communications improvements. Such is hardly the case. The flexible

[3]Constantinos A. Doxiadis, "Man's Movements and His City", *Science* 162 (18 Oct., 1968), pp. 326-334.

mobility and speed of the automobile are limited to those who can afford them — certainly a small fraction of the human community. Some cultures are bound in space by the iron laws of distance and the limited capacities of beast-of-burden. Indeed, if accessibility to new transport opportunities is constrained by income, then there is reason to suspect that such advances actually widen the socio-economic rifts between "haves" and "have-nots". Evidence suggests, for example, that minority groups in the central areas of certain American cities have become locationally less accessible to such public services as bus routes and emergency health care and to jobs. In contrast, the accessibility to services and jobs for the suburban middle and higher income groups has shown marked improvement.[4] This whole question on the equitable allocation of transportation benefits is of central significance to many conflicts at local through global scales.[5]

Human Extensibility

Human extensibility is conceptually the reciprocal of time-space convergence. Instead of focusing on the improved abilities for movement over greater distances it may be more appropriate to consider the expansion of opportunities for human interaction. In a figurative sense, "as the world shrinks, man expands." For example, with communications advances, politicians may project their images and messages over territories of increasing size to larger numbers of people. As Lewis Mumford has noted:

> Perhaps the greatest social effect of radio-communications, so far, has been a political one: the restoration of direct contact between the leader and the group. Plato defined the limits of the size of a city as the number of people who could hear the voice of a single orator: today those limits do not define a city but a civilization.[6]

Again, however, inequalities exist. We are not all in positions to project our images, needs or presence to large and responsive audiences. Although the distinctions between the poor and the affluent and between the powerful and the oppressed at local levels come immediately to mind, similar inequalities exist at the world scale. The extensibilities of the U.S. and the U.S.S.R. are indeed global. No other nations are within thirty minutes of all points on the earth and only a few other nations have the transport capabilities for making their presence felt within twelve hours. The communication of national policies to world-wide audiences is similarly restricted. As William Bunge and William Warntz have noted, the topology of the humanized-Earth is undergoing fundamental alteration as a consequence of the changing dimensionality of movement technologies.[7] They observe that the boundaries among nations are no longer lines but surfaces. The U.S. and U.S.S.R. have surface contact with all nations of the World — a locational pervasiveness which makes their global extensibility unparalleled.

Suggested Student Exercises

Human extensibility and time-space convergence are identified in this paper as measurable trends which are having

[4]For example, see *Antipode: A Radical Journal of Geography*, "Access to Essential Public Services," Vol. 3, No. 1 (November, 1971). Also, see Donald R. Deskins, Jr., "Residence-Workplace Interaction Vectors for the Detroit Metropolitan Area: 1953 to 1965", in *Special Publication No. 3*, Interaction Patterns and the Spatial Form of the Ghetto (Department of Geography, Northwestern University, 1970), pp. 1-23.

[5]The moral implications of spatial patterns are discussed by David Harvey, "Social Justice and Spatial Systems," in *Geographical Perspectives on American Poverty*, edited by Richard Peet (Worchester, Mass.: Antipode Monographs in Social Geography, 1972).

[6]Lewis Mumford, *Technics and Civilization*, (New York: Harcourt, Brace and Co., 1934), p. 241.

[7]William Bunge and William Warntz, *Geography, The Innocent Science* (forthcoming).

profound effects upon the human condition and upon the human organization of space. It is for this reason that I recommend exposing students at all levels to these ideas. From a research perspective, empirical evidence in this area of study is inadequate and the theory of social and organizational response to these new technologies is weak. The classroom-field work exercises suggested here are intended to help bridge the teaching-research gap by making one a part of the other. Some of these exercises have been successfully tried and some await development. The details for implementing these projects are left at the discretion of the reader to work out in relationship with the level of student background.

1) *Plotting and Interpreting Convergence Curves.* — Convergence curves, similar to that shown in Figure 1, may be plotted from data available in transport timetables. These are generally found in museums, libraries and transport company files. The Transportation Center Library at Northwestern University has perhaps the largest collection of stage coach, steamship, railroad and airline timetables in North America. The Transportation Revolution, a book by George R. Taylor,[8] provides considerable general information on travel-costs and travel-times for nineteenth century North America. In addition, more current travel-times via automobiles are available through many state and provincial highway departments. The calculation of convergence rates and the general properties of the convergence curve are discussed in the January 1968 issue of *The Professional Geographer.*[9] Aside from providing a measure of transport innovation, the convergence curves and rates provide opportunities for speculation. Why are some places more convergent upon the total settlement system than other places? Why are certain routes selected for transport improvements as opposed to others? What are the social, economic and political implications of inequitable and spatially biased changes in accessibility patterns among cities and within cities? If one is willing to accept the inadequacies of linear extrapolation, convergence rates may be used for forecasting the future time-space structures of settlement systems. More advanced students, however, may wish to characterize the convergence curve with differential or difference equations.

2) *Asymmetric Distance and Space Inversions.* — A second set of exercises can be designed about the asymmetric travel-time properties of certain types of transport routes and about what William Bunge has described as space inversions.[10] Figure 2 shows time-distance curves for barge traffic along the Volga River. Barges require 102 hours to travel 1,400 miles downstream from Gorki to Astrakhan, but 220 hours when going upstream. Space inversions represent a similar such problem. This occurs when the order of distance or nearness among a set of places is altered. For example, via regularly scheduled commercial air travel, Chicago is closer in time to Denver than is Durango, Colorado. Yet Chicago and Durango are respectively 900 and 225 air-miles from Denver.

The space inversion and the asymmetric travel-time properties

[8]George R. Taylor, *The Transportation Revolution, 1815-1860,* (New York: Rinehart and Co., Inc., 1951).
[9]Janelle, "Central Place Development in a Time-space Framework", *Ibid.*
[10]William Bunge, *Theoretical Geography* (Lund, Sweden: Department of Geography, The Royal University of Lund, 1962).

of certain routes would appear to have significant implications for understanding human spatial organization and notable effects on the economic geography or raw material flow, industrial development and urban growth. Yet, they have received only scant attention in our geographic literature. The development of classroom exercises around these ideas from the readily available time-tables of major transport companies could contribute to descriptive understanding and might spark the enthusiasm for more conceptually based research.

3) *The Dispersed Family.*—The social implications of time-space convergence are readily inferred from what might be called the dispersed family effect. Evidence suggests that, since the 1930's, the average distance separating first, second and third generation kinship ties has increased markedly.[11] To what extent has this diminishing spatial cohesion of the extended family

11.Unpublished research by author.

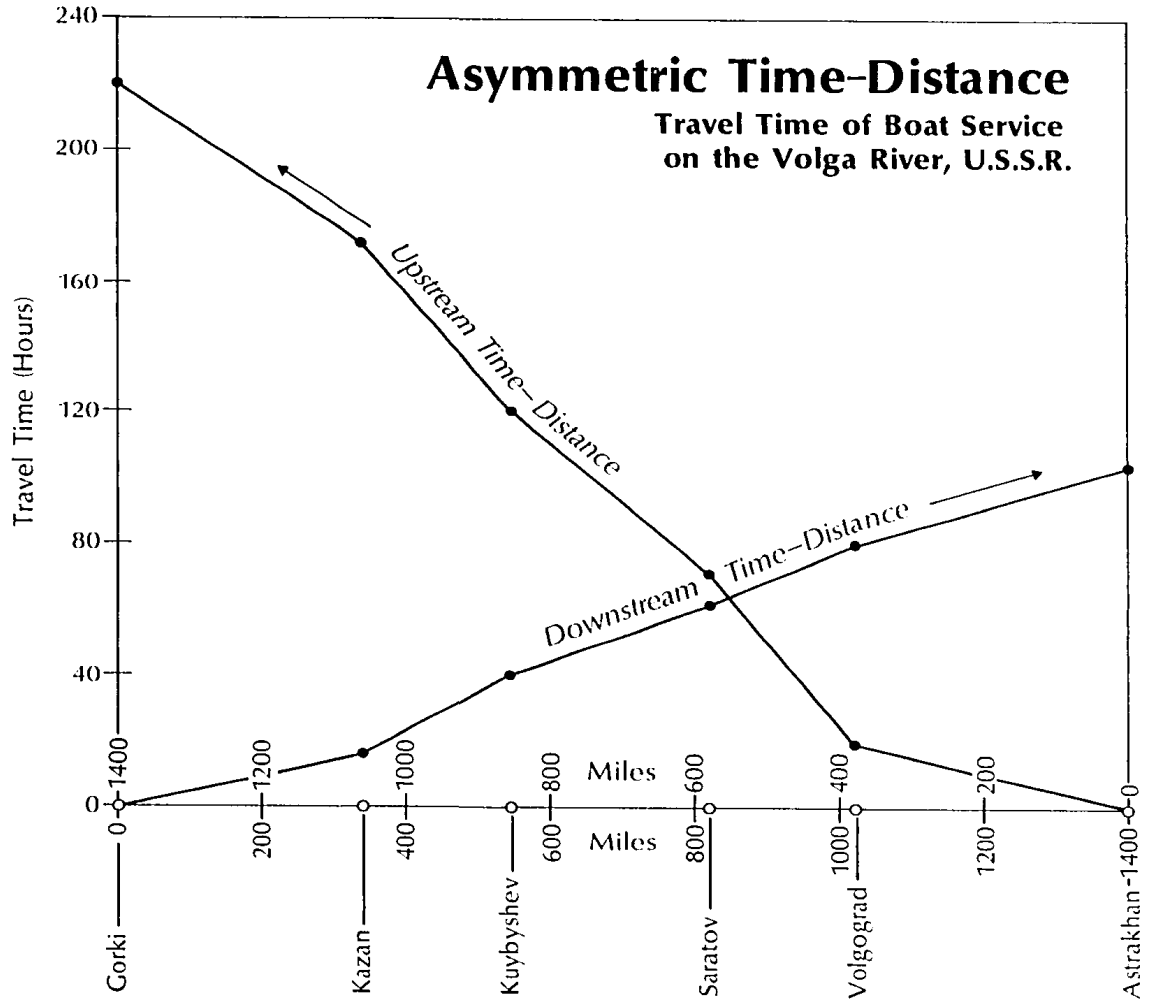

FIGURE 2

resulted in a corresponding loosening of familial bonds? To what extent do mail and telephone communications among family members substitute for direct visits? Students studying the dispersal of their own families and the communication patterns among family members could add materially to understanding a phenomenon which is, in part, a direct consequence of modern technology and which has not been sufficiently explored.

4) *Mapping Human Extensibility.* — At a more macro-scale, students could map the places of origin for all news items they learn of in a given day, week or year. Where are the blank areas on such maps? What does this tell us about world-wide communication patterns and the extensibility of different parts of the human community? How will such maps change through time? How do those compiled in Harlem differ from those drawn in Westchester County? What mass media biases are revaled?

5) *Communications Specialization and Extensibility Networks.* — Paralleling the dramatic increase of information flows has been a related trend towards information specialization. In spite of efforts to augment interdisciplinary exchanges, geographers continue to communicate mostly with and for geographers. The extensibility of a geographer depends, in part, on his access to the network of geographers. The universality of this trend has been enhanced by developments of inexpensive duplication equipment and closed circuit communications facilities. Radio and television stations, newspapers, magazines and journals in ever-increasing numbers are catering to specialized interest groups and subcultures. To mention only a few, these include ethnic minorities, religious groups, age groups, males, females, sporting and hobby interests, academic sub-specialities, revolutionaries of various persuasions and so forth. The social-cultural cohesion of nations and cities is changing in response to these trends. New kinds of regions are emerging; these regions are defined by flows of information, their subsets are not necessarily spatially contiguous, they are not necessarily permanent and yet they are mappable. The region of subscribers to the *Wall Street Journal* is likely to differ significantly from those of *Ebony* or *Ramparts*.

These and the thousands of other kinds of regions which make up the human landscape can be investigated through student exercises. Whereas the identification of the region in and of itself may be of little value, student attempts to explain such regions and to associate them with other socio-economic phenomena should lead to greater understanding of the relationships of human interaction systems with changes in human values and technologies.

Conclusion

Classroom exercises developed around the ideas presented in this paper should provide an incomplete but important glimpse on the array of issues which communication and transport technologies pose. The concept of time-space convergence provides one measure of technological change and the concept of human extensibility, although less rigorously defined, offers one descriptive statement on the effects of convergence upon human interaction patterns and potentials.

The more traditional questions of

transportation and communication geography have concerned journey to work and migration patterns, traffic flows, accessibility measures, minimal routing paths, network simulation and interaction studies based on variations of the gravity model. These ideas will continue to warrant attention in both teaching and research. Many questions stemming from these investigations remain unanswered. Nonetheless, this does not rule out the necessity for broadening the scope of our questions whenever the patterns of human behavior suggest major breaks with the past or whenever our previous questions fail in leading us towards required solutions. The convergence and extensibility ideas are suggestive of new ways for considering old questions and of new avenues for geographic exploration. It is my hope that the scope of our instructional approaches in the geography of transportation and communication can be correspondingly broadened.