

INDIVIDUAL MOVEMENT AND COMMUNICATIONS FIELDS: A PRELIMINARY EXAMINATION*

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The spatial structure of an individual's communication field represents the outcome of a series of decisions, often based on incomplete information, relating to the opportunities available for interaction. Communication patterns reflect both the high degree of areal specialization that characterizes the human landscape and the spatially variable levels of information an individual possesses about his environment; thus a set of linkages is formed varying in intensity over time, from person to person, and from place to place. Patterns of individual movement are influenced not only by the information gathered as the individual travels from place, but also by the information he is exposed to by virtue of his position in various socio-economic groups. Repetitive trips to school, to work, to shops, and repeated communication with friends, neighbors, and business associates increase the individual's level of knowledge about his spatial environment and result in interpersonal movement patterns that are stable in the short run [3].

Although several investigators have speculated on the degree of correspondence between individual movement patterns and individual communication patterns, data are now available for the first time to test explicitly the hypothesis that movement patterns provide a viable surrogate for communication patterns.

Background

Hägerstrand's work during the early 1950's provided the stimulus for most subsequent studies by geographers of the spatial diffusion process. The original models proposed by Hägerstrand [2] included three notions relevant to an explicit spatial formulation: (1) the two-dimensional lattice with evenly spaced lattice points, (2) the mean information field, and (3) the existence of discontinuities between certain of the lattice points. Recent research has generalized the Hägerstrand models to cover irregular lattice structures, but only moderate attention has been given to the latter items (Morrill and Pitts [5], Marble and

*The support of the Agricultural Development Council and the Geography Branch, Office of Naval Research, is gratefully acknowledged.

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Bowlby [3]). The mean information field (MIF) expresses the decline of the probability of information transfer as a function of increasing distance from the location of the information source. This information field is, then, an example of a spatial autocorrelation function since it defines the dependence of an event (receipt of information) upon conditions existing at positions surrounding it (number and location of senders of messages). The discontinuities incorporated in the original Hägerstrand models are sharply defined in a spatial sense and impose abrupt (and localized) shifts in the character of the distance decay function that defines the information field. In the original Hägerstrand models, these discontinuities usually represented localized physical barriers to movement and communication. The conceptual development of the information field is sketchy at best, and existing empirical work emphasizes our lack of knowledge of this complex function. The early work by Marble and Nystuen [4] identified the problem of developing direct measures of community information fields, and Morrill and Pitts [5] subsequently discussed a number of common measurement surrogates and examined a series of different functional forms relating distance and contact frequency. Marble and Bowlby [3] utilized actual household travel patterns in an urban area to compare social contacts with one of the more commonly utilized surrogates. They concluded that this surrogate measure, marriage distances, tended to overestimate the spatial extent of the information field when compared with the household's pattern of social contacts.

The aggregate information field is commonly referred to as the mean information field. The term "mean information field," though well established in the literature and likely to remain so, is an unfortunate one. Rather than being a mean, it represents instead an aggregation of personal, or individual contacts; rather than a "field," it is a one-dimensional representation of the two-dimensional distribution that characterizes a field. As it is usually constructed, the mean information field expresses in only one dimension the decline of the probability of information transfer as a function of increasing distance between the recipient and the information source. Because of the strong spatial filtering implicit in the construction of the mean information field, the generality of our knowledge about spatial patterns of interpersonal communication has been limited.

The problems of spatial filtering in the mean information field can be understood more clearly by showing how it is constructed. To determine an appropriate distance decay function to fit empirical data, the following steps are necessary: (1) map all recorded contacts as points about a common origin, (2) map the points of the resultant two-dimensional distribution into a single dimension, and (3) fit a function to the one dimensional frequency distribution. Step 2 clearly eliminates any irregularities on the surface representing the probabilities of contacts by smoothing over any peaks, ridges, troughs, or directional discontinuities that might exist; so assuming the slope of the fitted curve is the same in every direction is not realistic. (Compare Figures 1 and 2.) Although Morrill and Pitts [5] experimented with several distance decay functions, none was found to represent adequately all types of contacts. The Pareto function, $Y = aD^b$, was found to be the best approximation for non-migratory contacts.

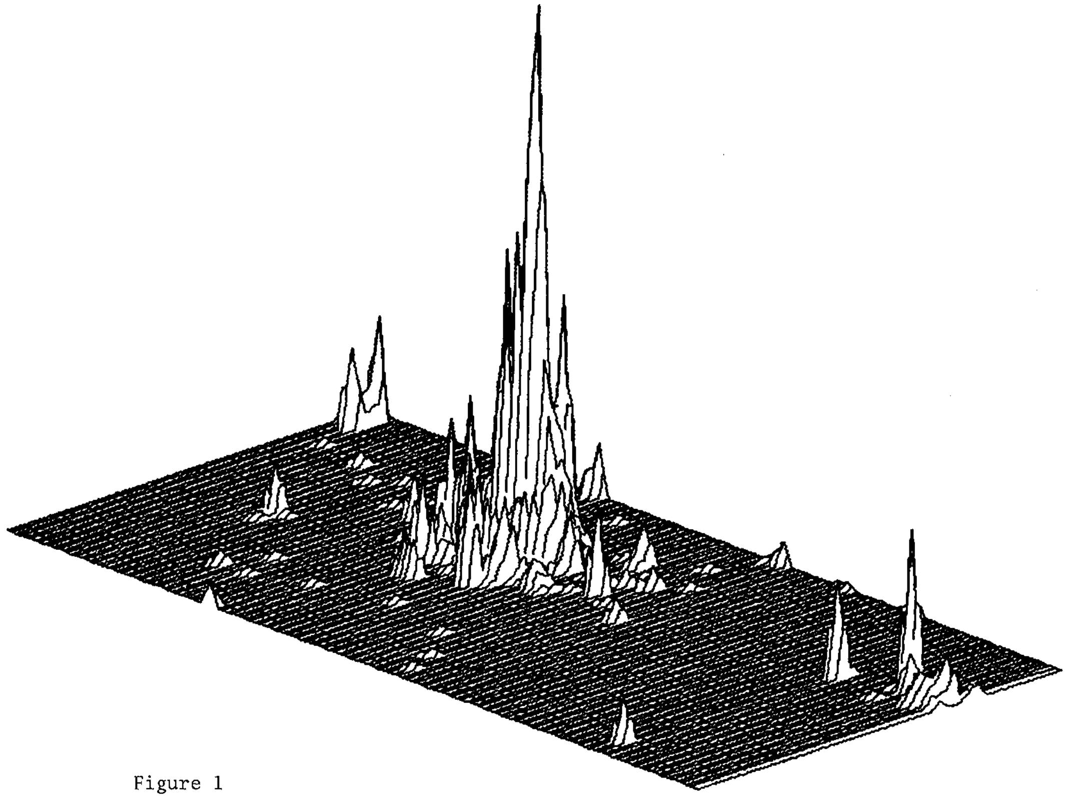


Figure 1

Actual Contact Densities as Derived
From Field Interviews
Rural Korea - 1967

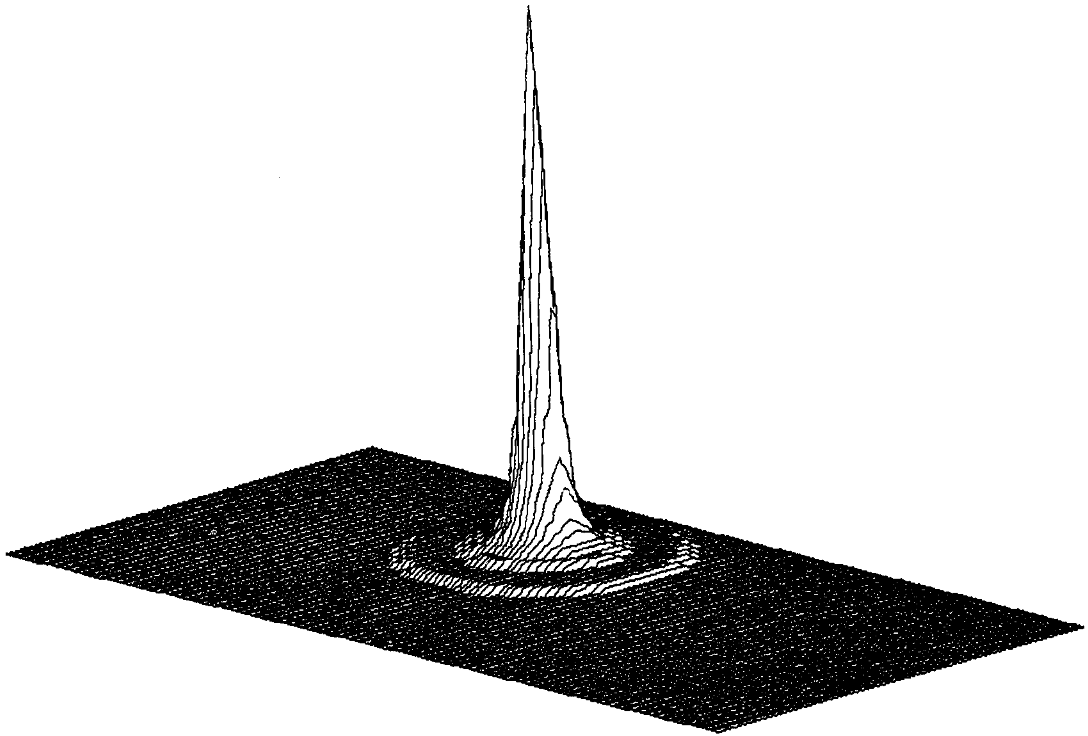


Figure 2

Predicted Contact Densities as Derived From the Estimating Equation

The relationship between the household's information field and its daily, recurrent movement pattern is evident since the former is usually defined as the set of locations at which face-to-face, interpersonal contacts are made, while the latter defines the set of all possible contacts of this nature. Within the spatial point set of trip ends lies a subset constituting the household's information field. The studies mentioned earlier have utilized a variety of surrogates and at least one of these - the spatial pattern of social contacts - would seem to be related closely, at least intuitively, to the information field. However, the direct relationship between movement fields and communication fields has not, to the best of our knowledge, been the subject of any previous empirical investigation.

The present paper presents some results derived from a pilot study carried out in a rural area of the Republic of Korea during the summer of 1967. The primary goal of the pilot study was to validate recall approaches to the collection of joint movement-communication data in a non-literate culture, and despite the severely restricted sample size, the substantive results are presented at this time because of the complete lack of any other empirical information.

The Field Study

Field studies were carried out near the city of Iri, a town of about 70,000 located on the Cholla Plain in the rice growing area of the Republic of Korea. (Figure 3). This area was selected because it met the criteria for a low literacy, low mass media impact situation and also because Dr. Seung-Gyu Moon of Chonpuk National University had recently completed a very detailed study for the Agricultural Development Council on innovative behavior of a sample of rural households in the area. Four households in each of three villages located near Iri City (Figure 4) were selected from those in Dr. Moon's sample. An extensive questionnaire was administered daily to both husbands and wives for a period of eight days. The questionnaire was based upon those used in travel diary studies in the United States, with some adaptation for the recall tests and modifications to include the communications items. It had been translated into Korean and field tested east of Iri near Chonju City.

Information was obtained on a total of more than 1,200 stops made by the twenty-four individuals during the eight day surveillance period. All stops and associated information were locationally coded on the basis of a common plane coordinate system in order to facilitate analysis.

Analysis

Only a coarse spatial analysis has been performed to date. The two-dimensional point patterns representing the locations of the stops with reference to the home as origin were translated to a common origin and filtered to a standard distance decay distribution by making ring counts. The standard approximating function for the resulting frequency distribution is the Pareto which has the form:

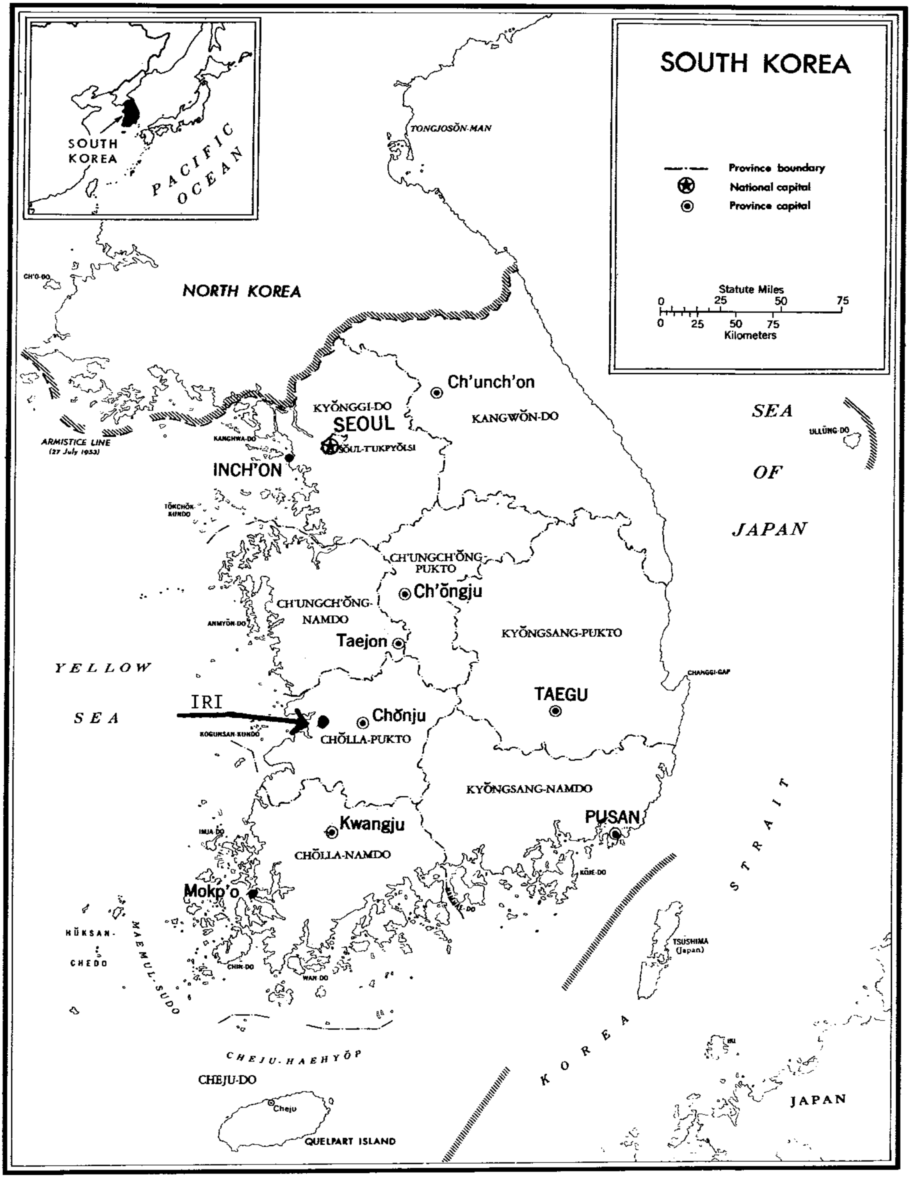
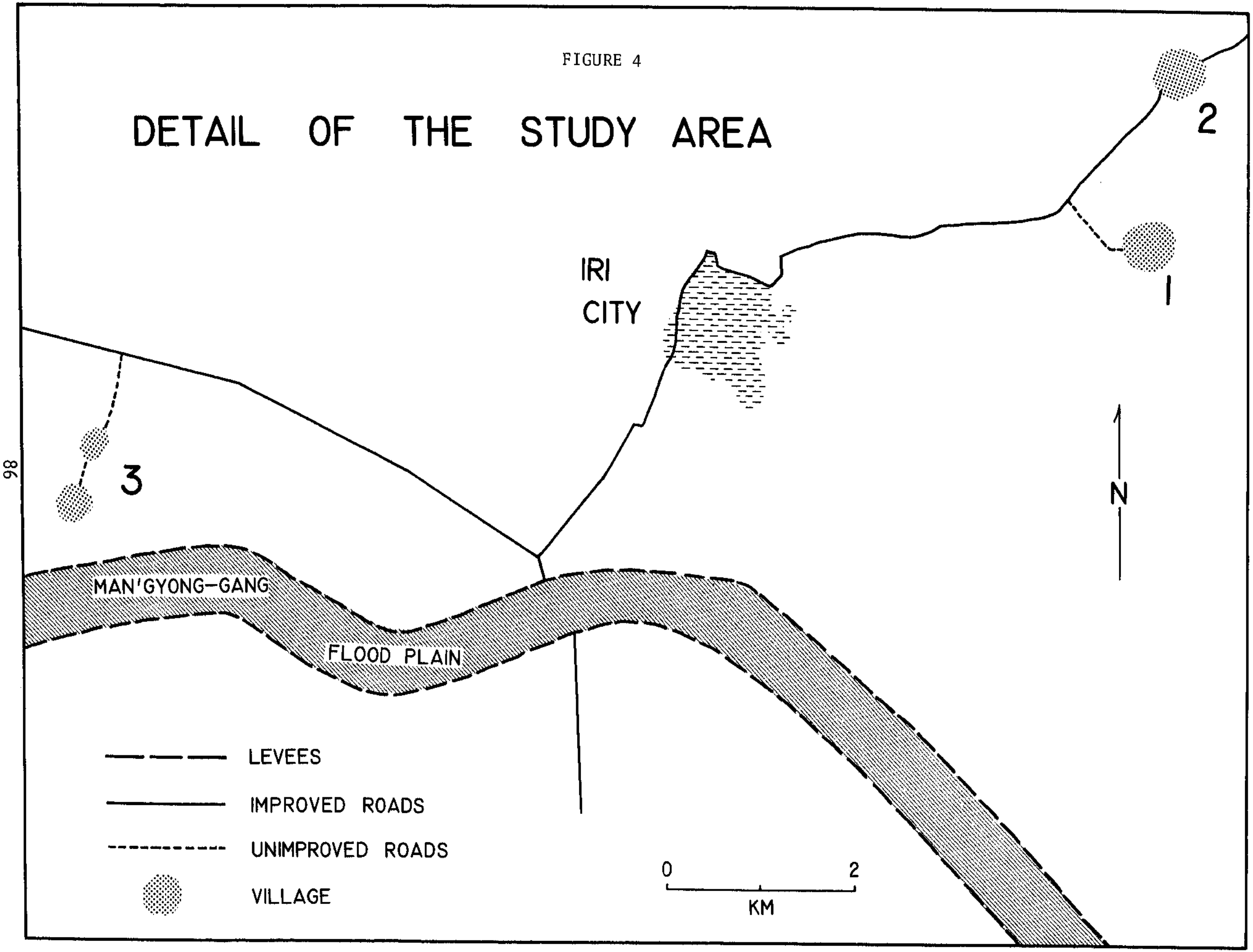


Figure 3

General Location of the Study Area

FIGURE 4

DETAIL OF THE STUDY AREA



$$Y = aD^b \qquad (1)$$

which may also be stated in a log linear form:

$$\log Y = \log a + b \log D \qquad (2)$$

The use of standard regression techniques produced the following results:

$$Y_T = 20.18D^{-2.037} \quad (r^2 = 0.88) \qquad (3)$$

$$Y_C = 15.03D^{-1.93} \quad (r^2 = 0.88) \qquad (4)$$

where:

Y_T = total number of stops per square kilometer

Y_C = number of communications stops per square kilometer

D = distance in kilometers from the common origin to the midpoint of each ring

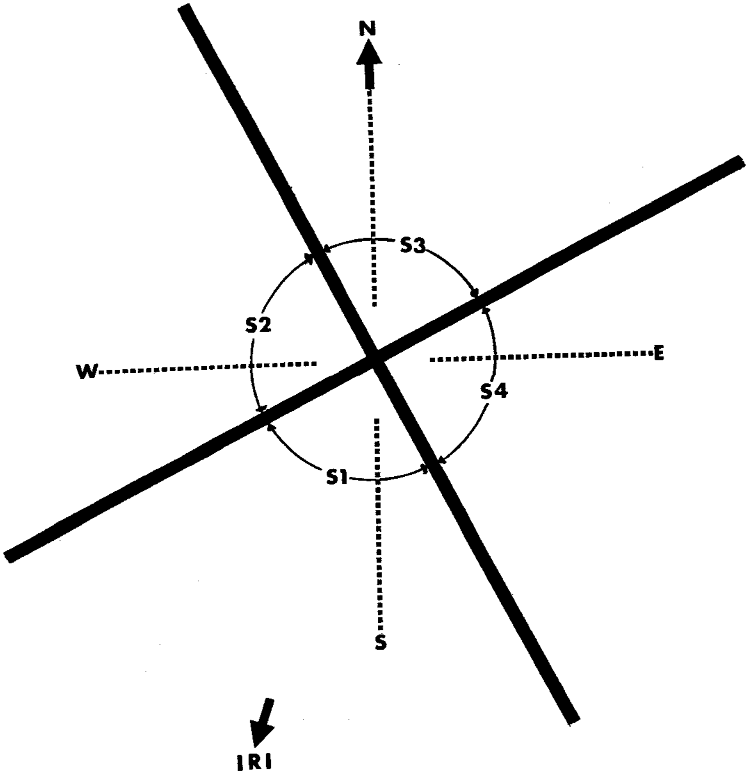
The slopes of these two equations are not significantly different from each other, nor from a value of two. The two intercepts do differ significantly at the 95 per cent level. At this level of analysis, we conclude that the total number of stops and the number of communication stops decay in an identical manner with increasing distance from the home and that communication stops form a distinctive subset of all stops. This would appear to validate the existing notion that movement fields provide an adequate surrogate for communication fields, and that they may be used as a baseline for the testing of other surrogates.

By definition, the mean information field has been subject to strong spatial filtering that has removed all directional bias. A second analysis was undertaken to determine if any such bias existed within the two fields examined here. Four 90° sectors were defined with the center of the coordinate system coinciding in turn, with the residence of each individual in each of the three villages. The sectors were then rotated until the centerline of sector one lay along a line drawn from the residence to the center of Iri. This produced a common "toward Iri" sector (sector one), as well as a common "away from Iri" sector (sector three). (Figure 5). Ring and sector counts were then made and observations aggregated over all observations in the three villages. Pareto distributions were fitted for each sector with the results as shown in Table 1.

Tests were made on each sectoral pair of distributions (total stops versus communication stops for each sector), and, in all four cases, the hypothesis that there was no significant difference between either the slopes or the intercepts was accepted. This provides additional support for the earlier conclusion that movement fields provide a suitable surrogate for communication fields. Tests of

Figure 5

Hypothetical Sector Orientation
After Rotation



the four sectoral slope values for total stops revealed a significant deviation from the overall value of two in three out of four cases. This is indicative of a directional bias in the fields. The bias appears to be related more to topographic variations near the individual villages than to any distorting effect of the city of Iri.

TABLE 1: Sector Summaries

	All Stops			Communication Stops		
	a	b	r^2	a	b	r^2
Total Field	20.16	-2.04	0.88	15.03	-1.93	0.88
Sector 1	44.30	-1.79	0.90	35.75	-1.66	0.92
Sector 2	54.89	-1.76	0.81	40.81	-1.65	0.83
Sector 3	34.92	-1.78	0.90	29.67	-1.80	0.92
Sector 4	23.91	-1.94	0.82	20.93	-1.90	0.84

The form of the contact or movement field would also seem to be dependent on the distribution of opportunities for contact. In the rural Korean situation the contact field represented by walking trips would be related to daily trips to the field, to neighbors, and to nearby places. Because agricultural fields are nearby and villages are small in spatial extent, we would expect walking trips to be a large but distinct subset of all trips and to have a decay rate that is steeper than that of the field representing all trips. Table 2 shows the parameters of the Pareto distribution that were fitted to the distribution of walking stops. Both the intercept and the slope of the walking distribution are significantly different from the intercept and slope of the composite distribution shown in Table 1. This finding supports the idea that walking trips are a distinct subset of all trips and spatially less extensive than all trips. (Figure 6).

TABLE 2: Walking Field Summary

	All Walking Stops			Walking-communication Stops		
	a	b	r^2	a	b	r^2
Total Field	14.88	-2.19	0.88	10.40	-2.11	0.88

Table 2 also shows the least-squares estimates of the slope and intercept for the communication subset of all walking stops. The slopes of the two equations, summarized in Table 2, are not significantly different from each other although the intercepts do differ significantly. At this level of analysis the conclusion is made that the distribution of total walking stops and the walking-communication stops vary in the same way with increasing

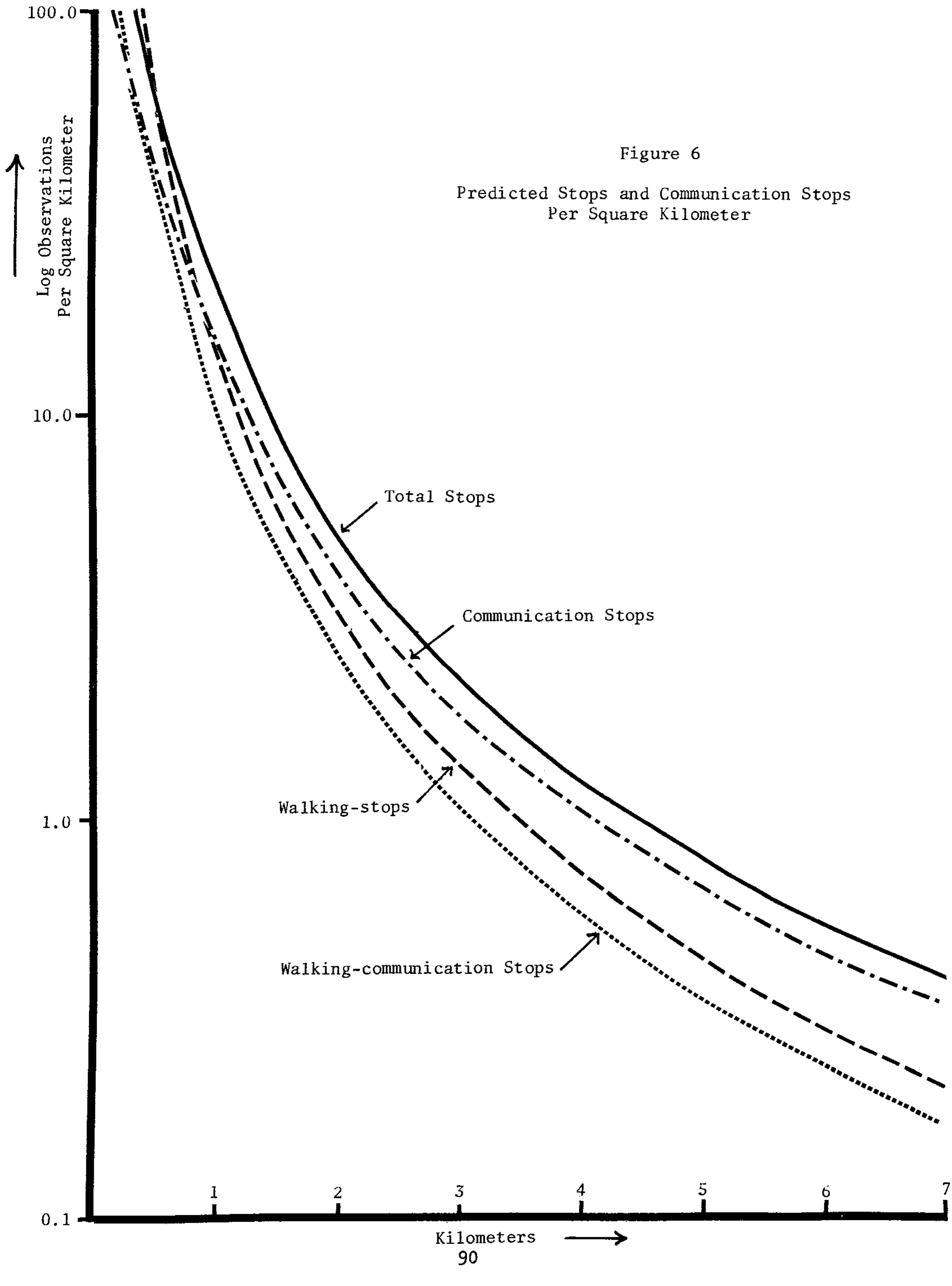


Figure 6

Predicted Stops and Communication Stops Per Square Kilometer distance from home and that the walking-communication stops form a distinct subset of all walking stops. The analysis on the walking subset of stops shows that the movement field provides a reasonably good surrogate for communication stops just as in the case of the analysis of the general movement and communication fields. The results also bear out, however, the importance of identifying distinct subsets of trip types to isolate components of the mean information field.

The gross spatial similarity existing between the two fields raises the question of possible temporal similarity as well. Trip generation studies in the U. S. have reported strong seasonal, weekly and diurnal variations in trip making (Garrison and Worrall [1]). The Korean surveillance period was too short to permit examination of seasonal or weekly shifts, but Figure 7 displays the diurnal pattern of total stops and communication stops. The proportion of communications stops to total stops shifts during the day, being greatest in the morning and evening hours.

Conclusions

Given the characteristics of the sample - a rural Korean population with a low level of literacy and relatively untouched by the impact of mass media - it is perhaps not surprising to find that a high degree of similarity exists between movement fields and communication fields; the former do seem to serve as a viable surrogate for the latter. This finding supports Marble and Nystuen's [4] hypothesis that communication and movement patterns are closely related; however, the relationship between the two patterns may not be as close in an urban environment. Communication patterns in a modern urban area are undoubtedly modified by the telephone and the availability of relatively high speed modes of transportation. Although we might still expect the largest number of interpersonal contacts to be face-to-face exchanges close to home, the close relationship between movements and communications found in this study may not hold when other forms of communication are included.

The identification of the separate components of the mean information field is important because the spatial structure of each component may be distinctly different from the form of the general field. In the Korean context the set of walking stops constitutes a distinct subset of the general movement field, while similarity still exists between the form of the walking movement field and the walking communication field. Although a walking component is relatively easy to isolate in the rural Korean situation, the complexity of travel patterns in an industrialized area would present quite different problems and the relative importance of different components of the mean information field would have to be reevaluated.

The concept of the personal information field and its extension to an aggregate information field is a useful one. Filtering a two-dimensional field to a one-dimensional structure as the mean information field does create a number of problems. The directional bias uncovered in the sectoral analysis above shows that the mean information field does smooth over irregularities in the field it represents. Clearly a method of analysis explicitly in-

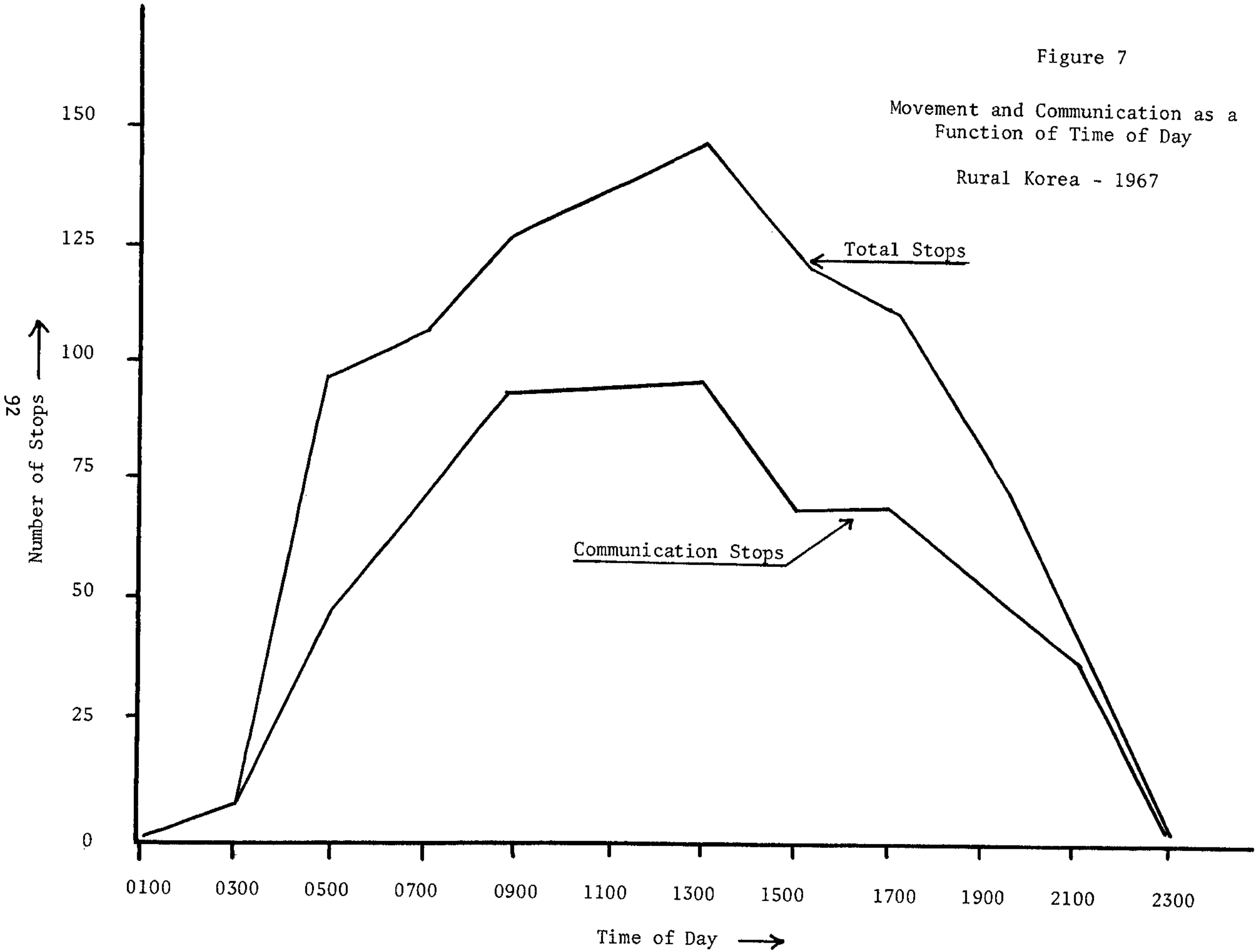


Figure 7

Movement and Communication as a Function of Time of Day

Rural Korea - 1967

corporating the two-dimensional nature of the aggregate information field needs to be developed.

To suggest that the gross patterns reported upon here would be characteristic of households in modern Western cities would be misleading. More extensive studies within both the rural and urban contexts are needed in order to provide greater insights into the relationship between movement and communication behavior in different societies.

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