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MAPS IN MINDS:
AN EMPIRICAL STUDY

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MAPS IN MINDS: AN EMPIRICAL STUDY

People's perception of the environment is of great interest to
geographers and planners.   The notion of "environmental perception"
is usually expressed in geographical literature by such terms as mental
map, awareness space or action space.   All these terms imply that the
spatial actor possesses some sort of internal mental ordering of the
external environment that he consults in the process of utilising or
responding to the environment.   It is generally believed that this
kind of "map" in the mind of the spatial actor will guide him in his
decision-making and will be of great importance in understanding and
predicting his spatial behaviour.

Although the study of mental maps has attracted increasing
attention among researchers within the last twenty years, the concept
of the mental map has probably had a much longer history.   However,
few empirical studies have been carried out to study the subject more
explicitly until recent years.   Richards (1974) has shown that this
concept dated back to the latter half of the 18th century in the
teachings of Immanuel Kant on "geographical space".   In modern
terminology, Kant considered that our daily spatial behaviour would
bring us to different geographical locations and that our perception
of these localities would appear in our minds in a piece-meal fashion,
especially for places farther away where contacts were less frequent.
However, in order to provide us with the notion of the completeness and
unity of the world, we should acquire a better knowledge of the environ-
ment beyond our immediate perception, and this could be achieved by
indirect means such as reading newspapers (and listening to his lecture).
Such ideas presupposed the importance of our spatial behaviour (i.e.
our activity space) and information diffusion (i.e. our indirect contact
space) in image formation.

In the present century, before empirical work on mental map was
formally undertaken by Lynch (1960), the concept has already been made
more explicit in other contexts.   Trowbridge (1913), often considered
as the pioneer of mental maps, discussed the problems of geographical

orientation in which he stressed the significance of what he termed "imaginary map". Later, Tolman (1948) put forward the "white-box" approach to the study of the stimulus-response system in which he equated the human mind to a map control room where the inputs from the environment were worked over and elaborated into a "tentative, cognitive-like map". This kind of map, with routes, paths and environmental relationships, would determine what output that would finally be released. These Tolmanian ideas, especially on the form of the cognitive maps, were later echoed and amplified in the studies of Lynch (1960) and Appleyard (1969). The notion of mental map was also specifically mentioned by Hallowell (1955) who was concerned with the way through which human beings linked up their diverse experience of the environment. He considered that to be spatially oriented, the actor must be aware of his own position in some spatial schema consisting of a set of reference points. These points, once known, were usually mentally manipulated and organized in the form of "mental maps" which would then provide the spatial actor a useful guide to action.

Since the late 1950's, thought-provoking empirical studies on mental maps have been undertaken by Lynch (1960), Gould (1966) and Appleyard (1969). These studies have stimulated considerable interest among geographers in the 1970's, cumulated in a variety of research works on urban images, especially in American and European cities.

Typology of Mental Maps

Although all mental map studies aim at revealing the cognitive image of the environment held by the spatial actors, there are different approaches in order to achieve such an objective. It is, therefore, possible to identify three different broad categories of "mental maps", which may be designated as locational schemata, cognitive maps and cognitive-affective maps.

Locational schemata are true mental "maps". In attempting to study a person's locational schemata, we are seeking to identify how he perceives the spatial forms of an area in terms of characteristics such as the location, extent, size and shape of environmental elements.

These elements would include, for example, transportation routes, neighbourhoods and activity nodes. We may also be interested in examining the distance and the directional relationships of these elements as well as the degree of distortion that may have occurred. Studies by Lynch (1960), Lee (1968) and Francescato and Mebane (1973), for example, fall into this category. Slightly different, but still recognisable as belonging to the locational schema category are studies of differential awareness of locations without considering the qualities attributed to these locations (e.g. Horton and Reynolds, 1971). The basic assumption in working with locational schemata is that the spatial actor does impose spatial order on the environment and behaves in conjunction with his locational map, however distorted and limited in scope.

Cognitive maps are somewhat different. In attempting to analyse the contents of a person's cognitive map, we are not seeking to identify a mapping of spatial forms and locational relationships, but rather the general "image" the individual has of a particular place. For instance, if someone is asked to answer the question of what Blackpool is like and he provides the stereotype answer of an entertainment centre (e.g. beer, bingo, theatres, discos, etc.) he is providing information about his cognitive map of Blackpool. Location may or may not be an important element in this map. It is least probable that he will describe Blackpool as lying at $3^{\circ}W$ and $54^{\circ}N$ or as being 85 miles to the west of Leeds. The term "cognitive" is used here to indicate the non-locational character of most images, and to suggest that thinking and verbal behaviour is a stronger component of these images than concrete visual imagery. In general, we would expect that cognitive maps of places an individual has actually visited would have a stronger element of visual memories, whereas places in his indirect contact space would tend more often to be understood in abstract verbal terms; however, considerable differences between individuals in this respect would be expected.

Cognitive-affective maps, on the other hand, are mental orderings of the environment that involve preference and choice. In this case, we are seeking to identify the elements that an individual prefers out of the environment and how he employs such preference to evaluate existing opportunities in the environment. This kind of analysis, if it is to

be done properly, involves three aspects: (a) the relevant characteristics that the individual thinks as significant in his choice-decision; (b) his image of the "ideal environment", i.e. the combination of relevant characteristics that it ought to have; and (c) the ways in which he compares his ideal image with his perception of existing opportunities in order to choose one of these opportunities.   These kinds of maps are called cognitive-affective maps because of their complementarity. By studying preference alone does not enable any prediction of behaviour to be made; we must also specify the opportunities that are actually perceived as being available, and this implies that the cognitive maps should also be identified.   In the ultimate analysis, identification of cognitive-affective maps is almost indistinguishable from the study of attitude and attitude change (Triandis, 1971).   The only basic difference is that the geographer is concerned with attitude towards places, whereas the social psychologist is concerned with the study of attitude in general.

Although it is possible to classify most perception studies into these three categories, based on the goal of the researcher, we should not oversimplify the situation by concluding that the spatial actor has three separate mental boxes labelled "location", "description of qualities" and "preferences".   In fact, there is considerable evidence to indicate that none of these kinds of ordering exists independently of each other. For example, the perceived location of an item is related to a person's preference for it.   Within certain limits, favourite items tend to be "moved closer" to the respondent and disliked items "pushed away". People distort physical distance to some extent according to the emotional distance between themselves and the located item.   Similarly, as Lynch argues, the perceived qualities of a place affect its perceived location. Places with contrast and distinction in physical qualities, and sometimes in social qualities as well, tend to be more accurately located than places with poor imageability.   Similarly, attitude theory (e.g. cognitive dissonance) suggests that once someone develops a liking for something , he would systematically distort its negative qualities so as to be consistent with his liking.   Conversely, for disliked items he would consistently downrate aspects of the situation that he would otherwise rate positively. Cognitive maps are thus distorted by preferences.   In short, the distinctions offered here are ways of classifying studies.   It is not to be concluded that the spatial actor keeps the categories of location, description and evaluation cognitively distinct.   On the other hand,

'it would be equally erroneous to conclude that he always perceives these
categories as one, as have some geographers who treat all mental maps
as spatially-oriented and map their results even though non-locational
considerations have been employed by the respondent.

Objectives of the Study

The present study is part of a broader project[*] which aims at revealing
how people perceive and evaluate their living environment with the belief
that the identification of the locational, cognitive and affective aspects
of mental images would be of practical importance in the design of future
planned human settlements.   This paper, however, is confined primarily
to the study of the locational schemata type of mental maps, i.e. it is
concerned with the spatial characteristics and locational relationships
of environmental elements that are being recorded in the minds of the
individual.   It seeks to identify the way and the extent in which people
mentally structure the environment into a coherent picture.   This does
not imply, however, that a composite map necessarily exists in an individual's
mind at any one time; but the "mapping exercise" employed in this study
provides the spatial actor with a chance to tie the loose pieces of informa-
tion together to show what he knows about the environment around him.   At
the same time, it is hoped that insight can be gained on the types of
environmental elements that are more likely to evoke a strong image in the
observer; in other words, on the "imageability" of urban features.

The Study Area

The study area, Tai Po, is a fast developing rural township in the
New Territories of Hong Kong (Fig. 1).   It has a population of 29,400
in 1976 (Census and Statistics Department, Hong Kong, 1978) and is located
about ten miles from one of the New Towns (Shatin) planned by the Hong
Kong Government.   Its growth during the last few years has been phenomenal
and is comparable to the New Towns in many ways.   As a potential area
for the overspill of the urban population from Hong Kong and Kowloon, it
has attracted the attention of both the private developers and the Government.

*Research project of the Geographical Research Centre, the Chinese University
of Hong Kong entitled "Environmental Perception of Residents of a Developing
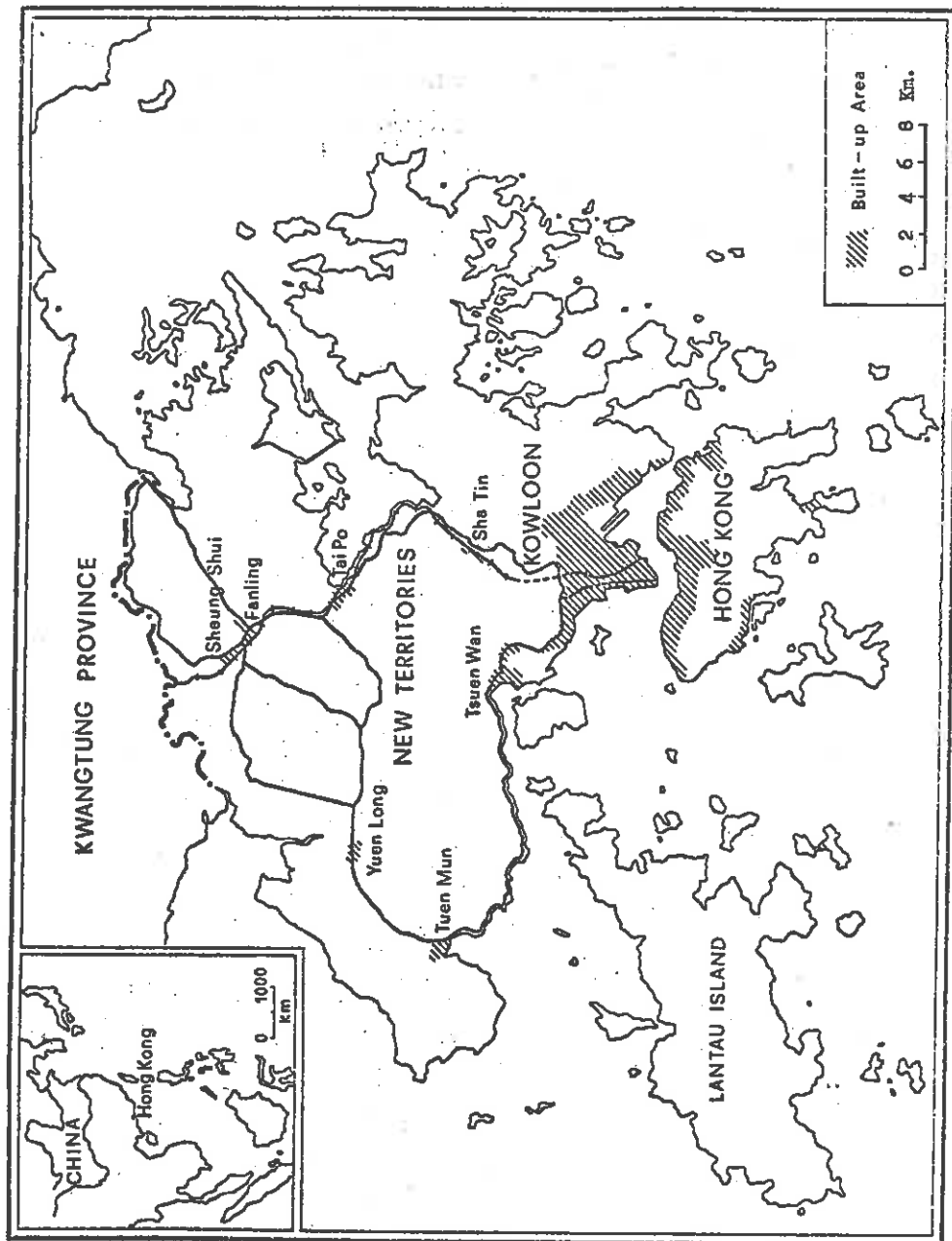Township: A Case Study of Tai Po" by K.Y. Wong and M.K. Lee Fong.

Fig. 1 HONG KONG, KOWLOON and THE NEW TERRITORIES

A large number of private multi-storey flats have been completed since
the early 1970's.   The Government's industrial estate project is now
under way and complementary developments in public housing schemes are
also being planned.   As a result of the gradual provision of basic
facilities, the increase in the housing stock and the comparatively
lower rental rates, there has been a steady inflow of people from the
urban areas into Tai Po.   Between 1971 and 1976, for example, 1400
households have moved in and its population has increased by 40% (from
20,938 in 1971 to 29,400 in 1976).   The ultimate target is to develop
Tai Po into a city of 220,000 people by the mid-1980's.   The town
itself has physically grown out of an old market but the developments
in the present decade has completely changed its form and structure.
This may possibly have several implications in our interpretation of
the mental maps of its residents.   In the first instance, approximately
one third of the present population have been residing in the study area
for less than seven years.   Most of these urban migrants belong to the
better educated middle class; but many of the indigenous population are
workers with a lower education standard.   In short, the population is
quite diversified in terms of demographic and socio-economic characteristics.
Secondly, the rapid pace in which old buildings are being demolished and
new ones constructed within the last few years has continually transformed
the townscape which may result in a low "legibility" of the town.   This
fact is reflected in many of the mental maps produced in which the landmarks
identified are sites of demolished buildings.   Thirdly, the town has a
fairly simple, regular layout as a result of recent planned development.
It can be seen from the town plan (Fig.2) that the built-up areas are
aligned between the main thoroughfare and the railway line in a more or
less grid pattern.   Intuitively, this may give the impression of a
fairly legible set-up.   However, what cannot be shown in the plan layout
is the vertical dimension.   With the built-up areas composed mainly of
closely-packed multi-storey residential buildings of similar size and
style in street blocks of similar shape, the ease of recognising and
differentiating the different parts of the town may be impaired, making
it difficult for certain people to organise it into a coherent pattern
because of the lack of "identity" of the individual elements.   A further
point is that no up-to-date map of the town is readily available to the
general public and there are no public locator-boards of the town on the
streets.   It is fair to conclude that the mental images of the town
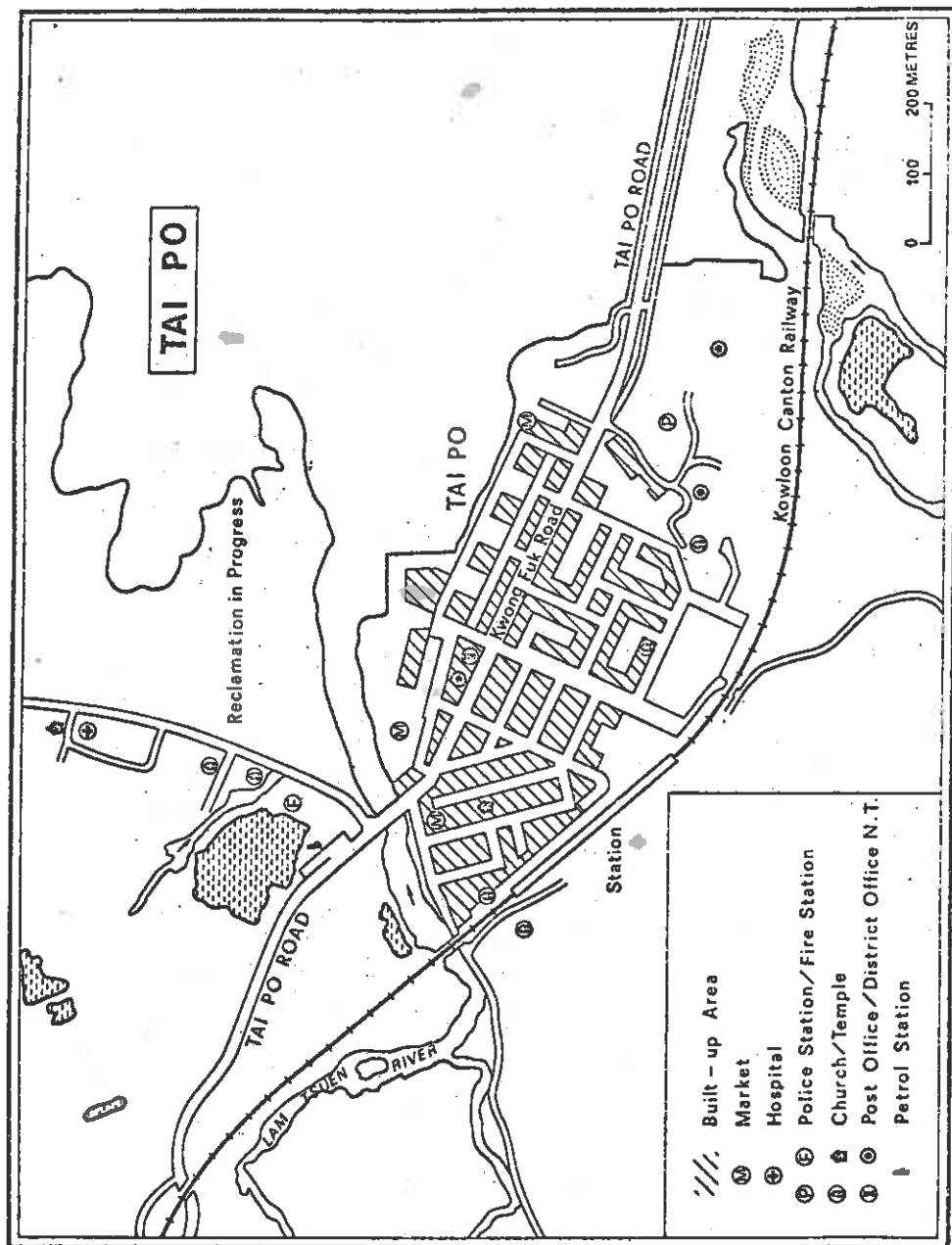
TAI PO

Reclamation in Progress

TAI PO

TAI PO ROAD

Kwong Fuk Road

Kowloon Canton Railway

TAI PO ROAD

LAM TSUEN RIVER

Station

Built – up Area
Market
Hospital
Police Station/Fire Station
Church/Temple
Post Office/District Office N.T.
Petrol Station

Fig. 2 TAI PO

.that the residents have acquired are largely through their daily spatial
behaviour, i.e. by personal experience.

Methodology

A random sampling method was used to select households for interview.
A total of 320 households were selected representing roughly 5% of the
total number of households in the study area.   If possible, the head
of the household would be interviewed; but if the head was not present,
then the head's spouse would be interviewed.   Apart from obtaining
information on demographic, socio-economic and housing characteristics,
a comprehensive investigation was conducted on the residents' degree of
satisfaction with different aspects of their living environment, and
attempts were also made to study the mental maps possessed by the residents
of Tai Po.   This paper is not concerned with the study on the degree
of satisfaction with the environment but rather focusses on the mental
mapping exercise.

As the main purpose is to study the locational schemata type of mental
maps, we are seeking to understand the way in which the environment is
being mentally organized by the individual.   The most appropriate method
seems to be recording the information from the respondents directly in
map form.   This is quite different from the cognitive-affective type
of mental map study in which the perceived quality of the environment or
the preferences for certain environmental opportunities are usually
elicitated by verbal means.   Some geographers (e.g. Gould, 1966) have
processed the data so obtained and presented them in map form, thus
producing mental maps by indirect means (e.g. Gould's isopercepts).
As the cognitive and/or affective components of an individual's mental
map need not necessarily involve spatial or locational characteristics,
such mental "mapping" is, strictly speaking, not appropriate.   This
is to assume that all actors are sharing the same predilection as the
geographers to express in spatial terms and it also assumes that people
perceive the opportunities in the environment as a continuous space which
is not necessarily the case.   In the study of the locational schemata
type of mental map, we are explicitly interested in the physical attributes
of the environment and in the way they are being organised in the minds
of the individual, and as such, direct mapping will give the desired

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result.

In the present study, respondents were asked to draw a sketch map
of Tai Po, the instructions being to aid a stranger to find his way around
the town.   They were free to put in whatever features they thought
appropriate in order to achieve such a purpose.   It was also emphasised
that the exercise was not an attempt to test their cartographic skill
and that they should not give any concern to their map-drawing abilities.
As this was a supervised exercise, there was no way in which the respon-
dents could consult maps or other references, and the maps produced were
thus based only on memory, i.e. on information about the environment that
were being stored in their minds.   This kind of mapping exercise is
obviously more advantageous than verbal expressions if the system of
interest is the locational relationships of spatial elements.   However,
there are also certain limitations that must be taken into consideration.
Despite the instructions given, the sketch maps produced will certainly
be affected by the "mappability" of the environmental elements and by
the ability of the respondent to express in cartographic form.   Hence,
it is expected that differences will exist between different groups of
people and between different places and cultures.   It has also been
pointed out (Pocock, 1976) that two other variables may also affect the
validity and comparability of results: the physical complexity of the
environment under study and the areal extent over which cognition is
demanded.   The greater the complexity and the areal scale, the more
difficult it is for the respondents to draw a coherent picture of the
environment.   In the study area, these should not present any serious
theoretical problem as the spatial extent of Tai Po is quite small and
the layout of the town is quite simple.   It is the similarity rather
than the complexity of the environmental elements that may possibly have
an effect on imageability and legibility.

In the broad survey of Tai Po, 311 interviews were successfully
completed.   But of all the residents who have responded to the
questionnaires, only about half (159) were willing to do the mapping
exercise.   Thirty-two of the maps produced were declared invalid
because they were drawn either as a cooperative effort by several
members of the household or by members (usually children) other than
the head of the household or his/her spouse.   An analysis of those

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respondents who have refused to do the mapping exercise reveals that 82% of them are either females or males over 50 years of age; 75% have either no education at all or only primary education; and 83% are housewives, retired persons, factory workers, hawkers or unemployed. This casual observation seems to echo the point made by Francescato and Mebane (1973) that mental map as a tool for information gathering is less suitable for certain population groups.

For the 127 cases available for analysis, an attempt will be made to study the composition and arrangement of the mental maps. The emphasis will be on map elements and styles, as well as on the degree of map sophistication. These will also be examined in relation to various characteristics of the respondents.

Map Styles

The first task of the analysis is for the researcher to identify the main elements and the way they are being structured in the maps produced by the respondents; in other words, to identify the different styles of structuring the town. This is no easy task because the maps drawn vary so much in form, in detail and in emphasis. An interesting classification of map styles was offered by Appleyard (1969) in his study of Ciudad Guayana, a new steel-producing city in Venezuela with a population of approximately 30,000, about the same size as the present study area, but with a greater spatial extent. Appleyard claimed that the sketch maps he obtained could be classified on the basis of two variables: the predominant type of elements used and the level of accuracy of the maps. As far as element types are concerned, maps can be classified as either sequential or spatial in character. Sequential maps are organised around major paths (e.g. roads) and imply that the resident conceives of the city as a set of movement experiences, while spatial maps organise the city into a static series of districts and landmarks. The sequential-spatial difference generally corresponds to Lynch's dynamic-static dichotomy. Both of these major types of maps can be subdivided into subtypes based on accuracy level or degree of sophistication. These range from the crude topological representations through linkages and interconnections to the more sophisticated positional representations. Eight types of maps are then identified. Such a scheme has provided the basis for a number of

research findings in recent years, though with different degrees of application. Pocock (1976), for example, has identified eleven different map styles for his study of Durham. For the present study, although there are certain similarities between Tai Po and Ciudad Guayana in population size and in other characteristics such as orientation along major transportation routes and the lack of a well-defined town centre, it is found that Appleyard's classification cannot be strictly applied. Many of the maps obtained from the residents of Tai Po cannot be fitted into Appleyard's specific map types, and a modified scheme has to be adopted.

The map styles identified and their frequency distribution in Tai Po are summarised in Table 1. Examples of the map types are shown in Figs. 3(A)-(D) and 4(A)-(D). Sequential-type maps are found to account for 83.5% of the total, indicating a strong dependence on major paths and movement experiences. This is similar to Appleyard's finding that 77% of all maps are sequential maps in Ciudad Guayana. This also supports Lynch's contention that most urban images are path-oriented. This is not surprising in Tai Po where the railway line and the main thoroughfare form the only links between the town and the other parts of Hong Kong. These are the paths in which most of the residents would frequent, especially for the newer residents who are largely commuting outside the town to work. The most primitive form of the sequential type is the line map (Fig. 3(A)) which tends to organise the city along linear features but which is highly schematic in form. It consists of a few lines which need not necessarily represent actual roads, and the direction and orientation are not necessarily correct. It is usually a representation of the respondent's movement path, normally to and from home. A more refined development of the line map is the arterial-and-branch type (Fig. 3(B)) in which the respondent identifies one major path of movement, usually the main thoroughfare or the road leading from the railway station to his home. Only relatively few branch roads are constructed away from the major path and no connections are made at the other end of the branch roads. These two types of maps together account for nearly two-thirds of all maps, indicating a generally low level in map details and the strong imageability of the most frequent movement paths. The last two types of sequential maps, the arterial-and-net (Fig. 3(C)) and the network (Fig. 3(D)) are better structured maps with various linkages of roads to form a system or network. The arterial-and-net map still focusses on the main arterial road but it also shows certain linkages

Table 1: Map Styles and Respondent Variables (%)

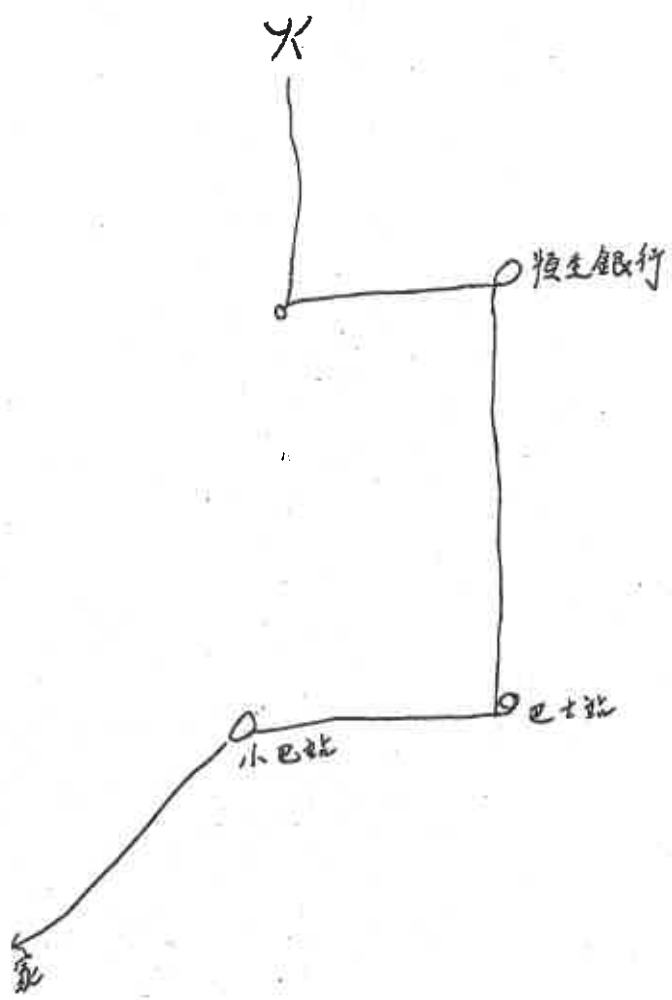|		SEQUENTIAL					SPATIAL					GRAND
		LINE	ARTER-IAL-AND-BRANCH	ARTER-IAL-AND-NET	NET-WORK	TOTAL SEQUENTIAL	SCATTER	MOSAIC	LINK	PATTERN	TOTAL SPATIAL	TOTAL
TOTAL	No.	39	44	11	12	106	4	2	12	3	21	127
	%	30.7	34.7	8.7	9.4	83.5	3.1	1.6	9.4	2.4	16.5	100.0
AGE	<40	32.9	32.9	8.9	12.7	87.4	1.3	2.5	6.3	2.5	12.6	100.0
	>40	27.1	37.5	8.3	4.2	77.1	6.2	-	14.6	2.1	22.9	100.0
SEX	M	24.4	39.0	9.8	13.4	86.6	3.7	-	6.0	3.7	13.4	100.0
	F	42.2	26.7	6.7	2.2	77.8	2.2	4.4	15.6	-	22.2	100.0
EDUCATION	NONE	60.0	20.0	-	-	80.0	20.0	-	-	-	20.0	100.0
	PRIMARY	40.0	35.0	5.0	-	80.0	5.0	5.0	10.0	-	20.0	100.0
	SECONDARY	28.6	35.7	10.0	11.5	85.8	1.4	1.4	11.4	-	14.2	100.0
	TERTIARY	18.5	37.0	11.1	14.8	81.4	-	-	7.4	11.2	18.6	100.0
OCCUPATION	UNEMPLOYED	37.9	34.6	3.4	3.4	79.3	-	6.9	13.8	-	20.7	100.0
	WORKING CLASS	47.4	23.7	2.6	-	73.7	7.9	-	18.4	-	26.3	100.0
	MIDDLE CLASS	16.7	41.7	15.0	18.2	91.6	1.7	-	1.7	5.0	8.4	100.0
INCOME* (per month)	LOW <$1000	80.0	6.6	-	-	86.6	6.7	6.7	-	-	13.4	100.0
	MEDIUM $1000–$2500	28.7	40.7	6.8	8.5	84.7	3.4	1.7	10.2	-	15.3	100.0
	HIGH >$2500	18.9	35.8	13.2	13.2	81.1	1.9	-	11.3	5.7	18.9	100.0
LENGTH OF RESIDENCE	≤10 YRS	34.0	36.2	6.4	14.9	91.5	-	2.1	4.3	2.1	8.5	100.0
	>10 YRS	28.8	33.7	10.0	6.2	78.7	5.0	1.2	12.6	2.5	21.3	100.0
MODE OF TRANSPORT	WALKING	39.0	32.2	6.8	5.0	83.0	5.1	1.7	10.2	-	17.0	100.0
	PUBLIC TSPT	25.5	36.2	10.6	10.6	82.9	2.1	2.1	8.6	4.3	17.1	100.0
	PRIVATE CAR	19.0	38.1	9.5	19.0	85.6	-	-	9.6	4.8	14.4	100.0

*£1≈HK$10.

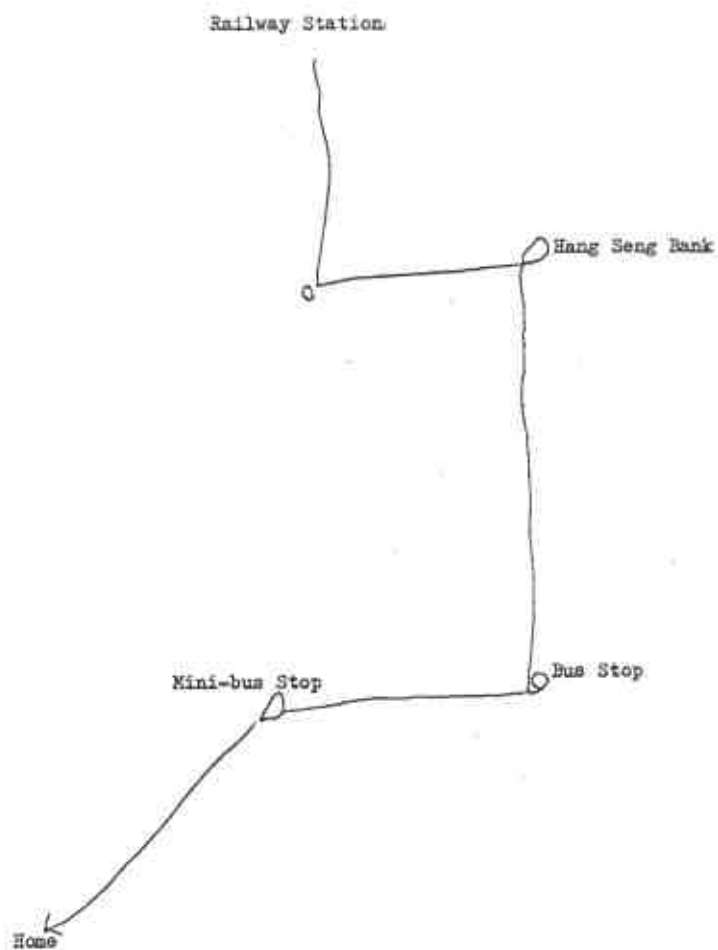Fig. 3(A) Sequential Map —— LINE

Fig. 3(A) Sequential Map — LINE

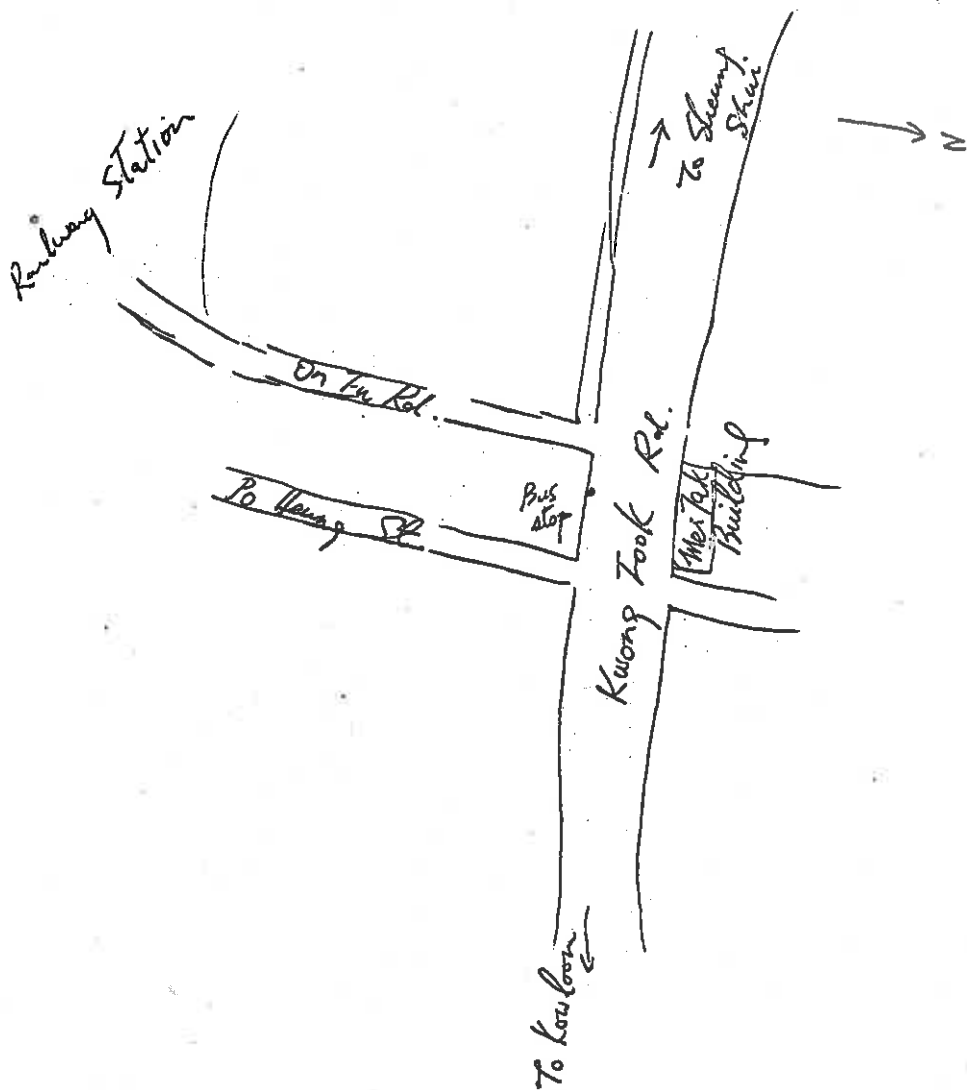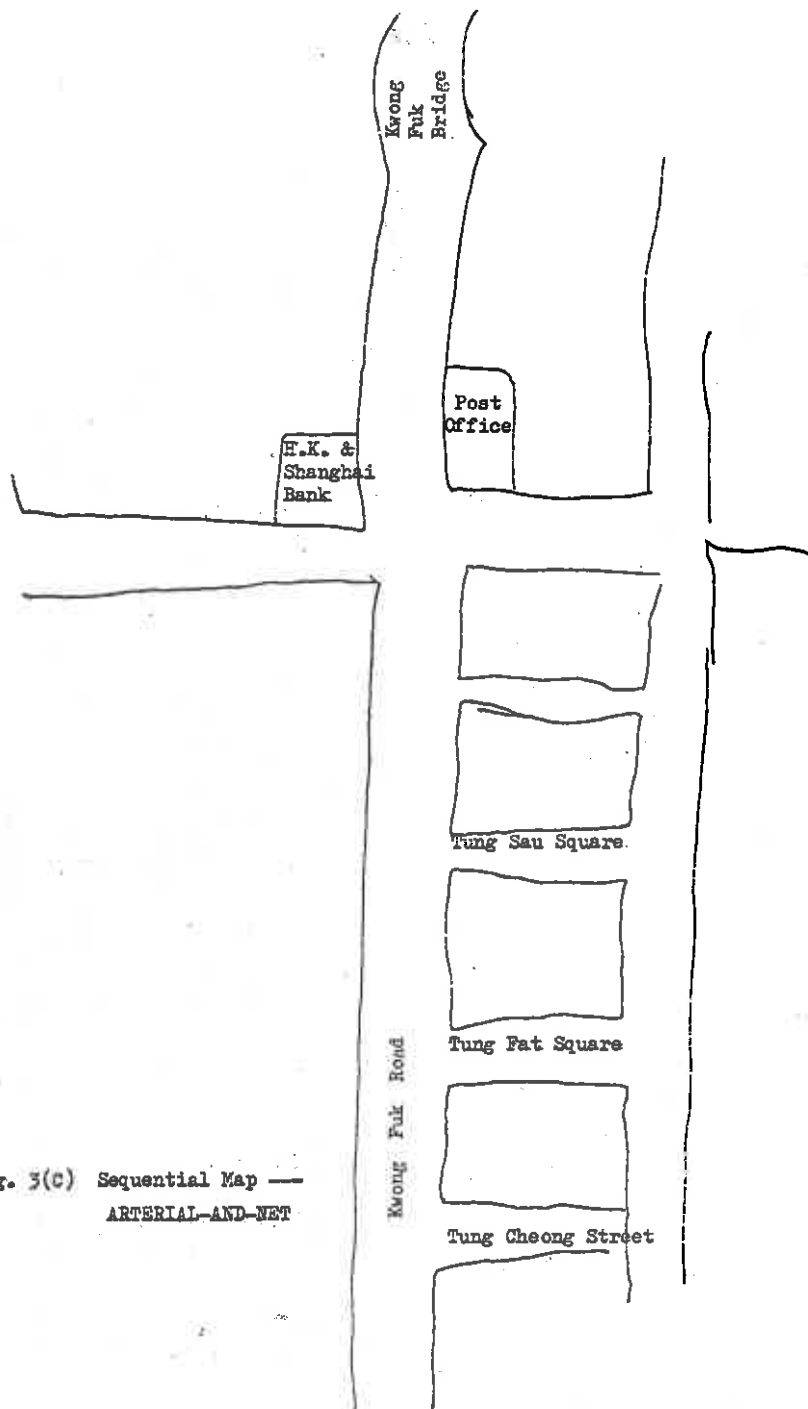Fig. 3(B) Sequential Map —— ARTERIAL-AND-BRANCH

Fig. 3(C) Sequential Map —
ARTERIAL-AND-NET
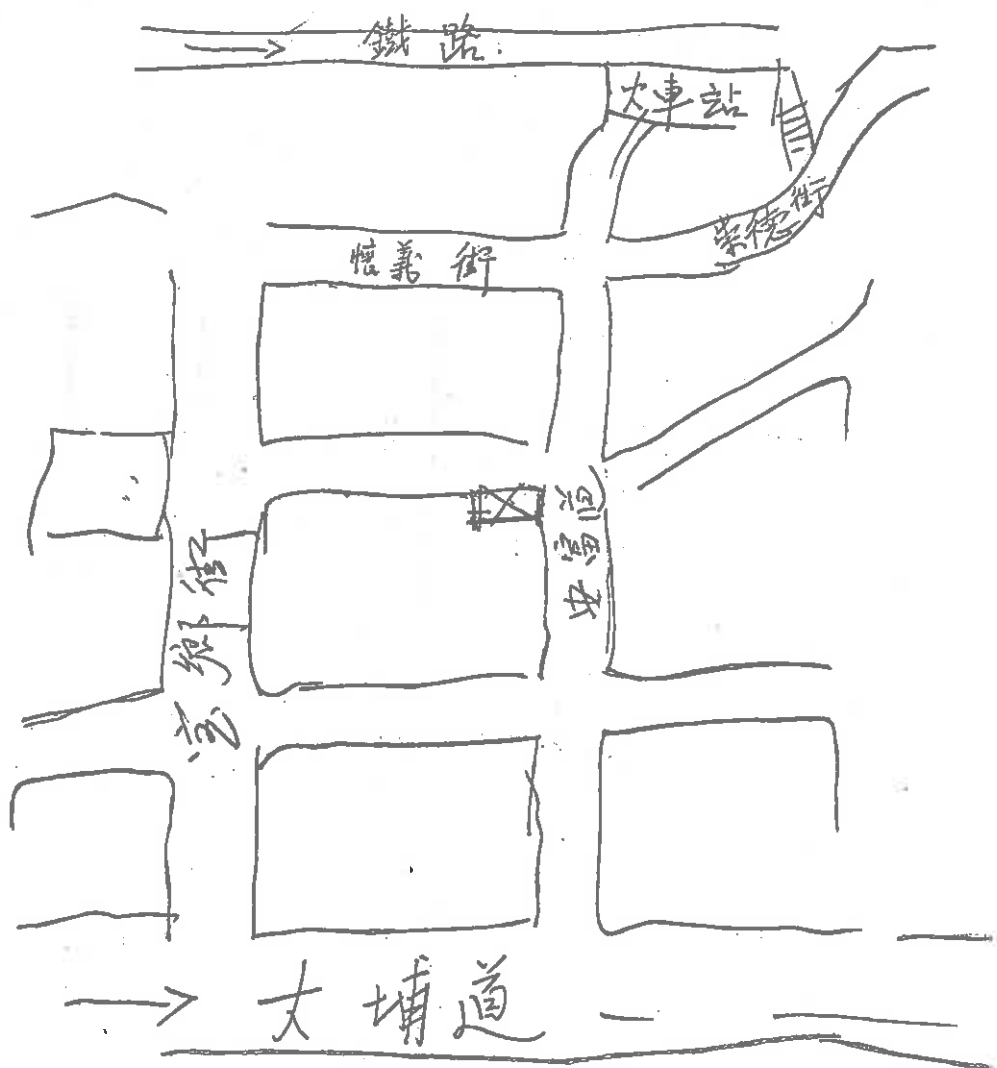
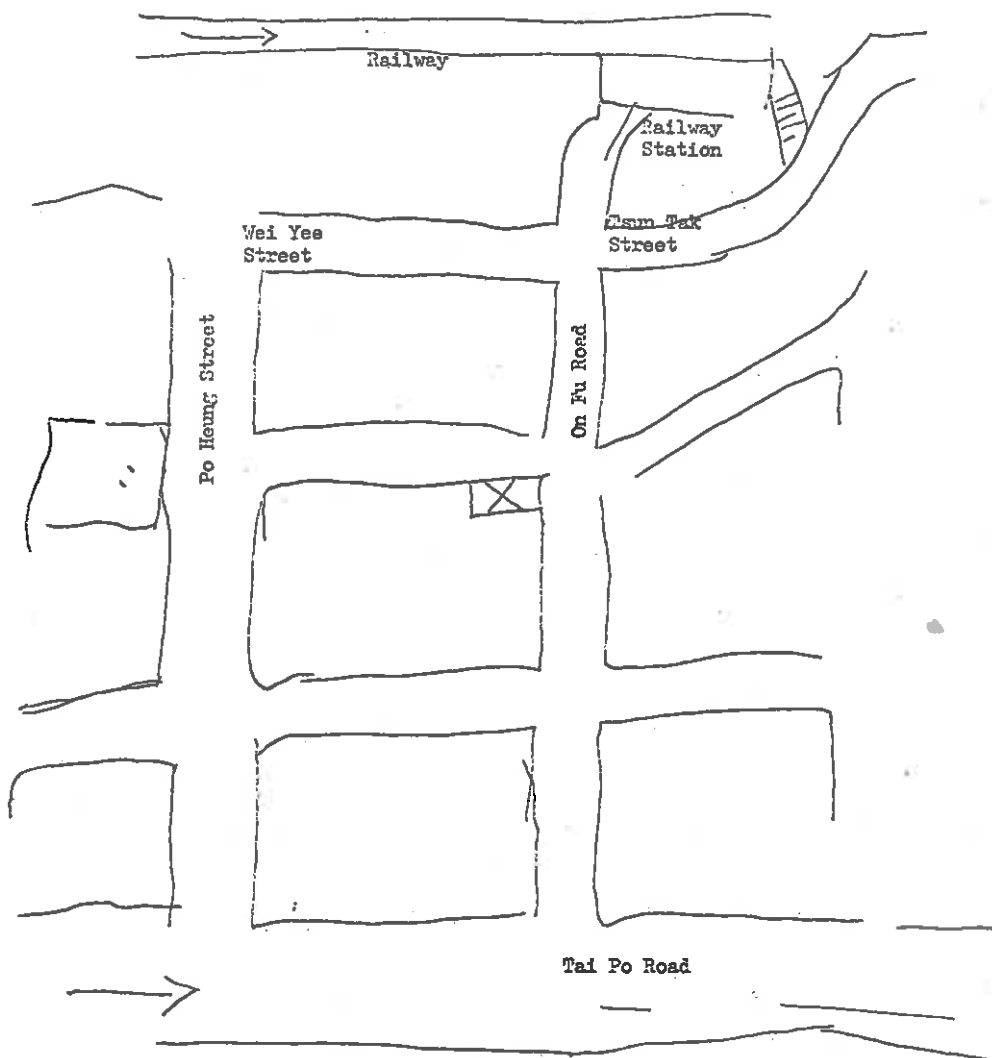Fig. 3(c) Sequential Map —
           ARTERIAL-AND-NET

Kwong Fuk Bridge

Post Office

H.K. & Shanghai Bank

Tung Sau Square.

Tung Fat Square

Kwong Fuk Road

Tung Cheong Street

鐵路

火車站

蔡德街

懷義街

毓鄉街

大埔道

Fig. 3(D) Sequential Map — NETWORK

Fig. 3(D) Sequential Map --- NETWORK

西　北

老圩

禁山

老街

差館

汽車塘站

東

Fig. 4(A) Spatial Map —— SCATTER

NORTH

WEST

Old
Market

Kam
Hills

SOUTH

Old
Street
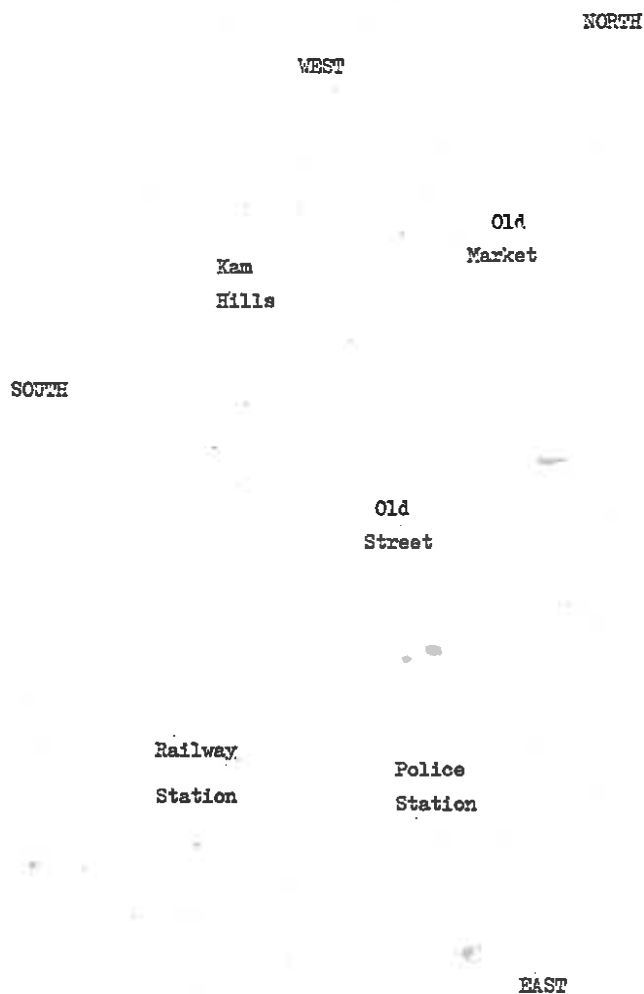
Railway   Police
Station   Station

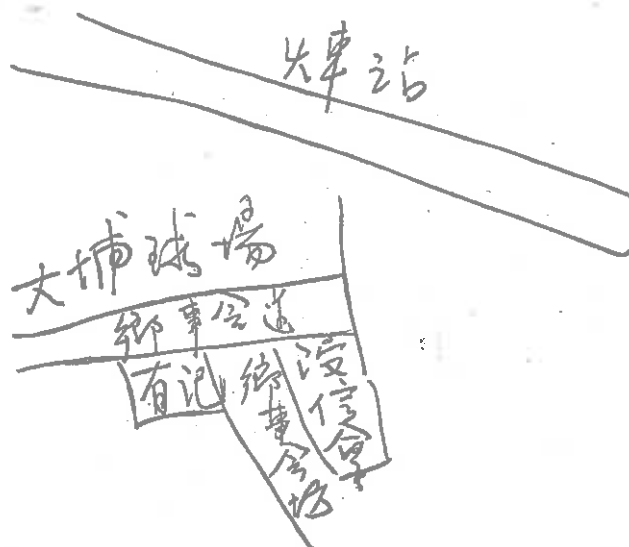EAST

Fig. 4(A) Spatial Map --- SCATTER
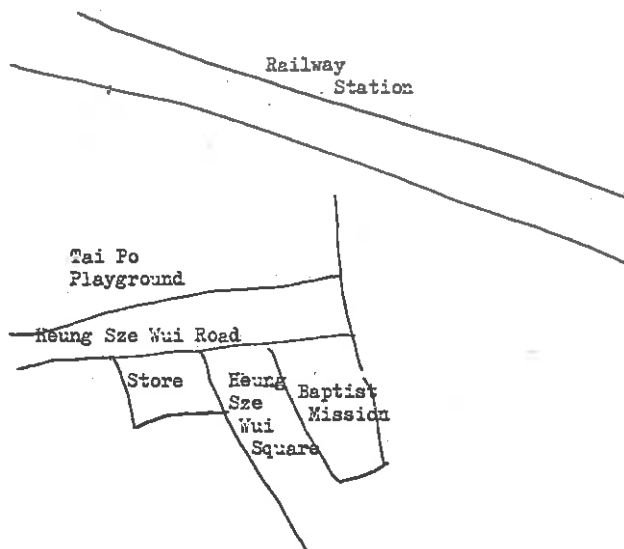
Fig. 4(B) Spatial Map —— MOSAIC

Fig. 4(B) Spatial Map —— MOSAIC

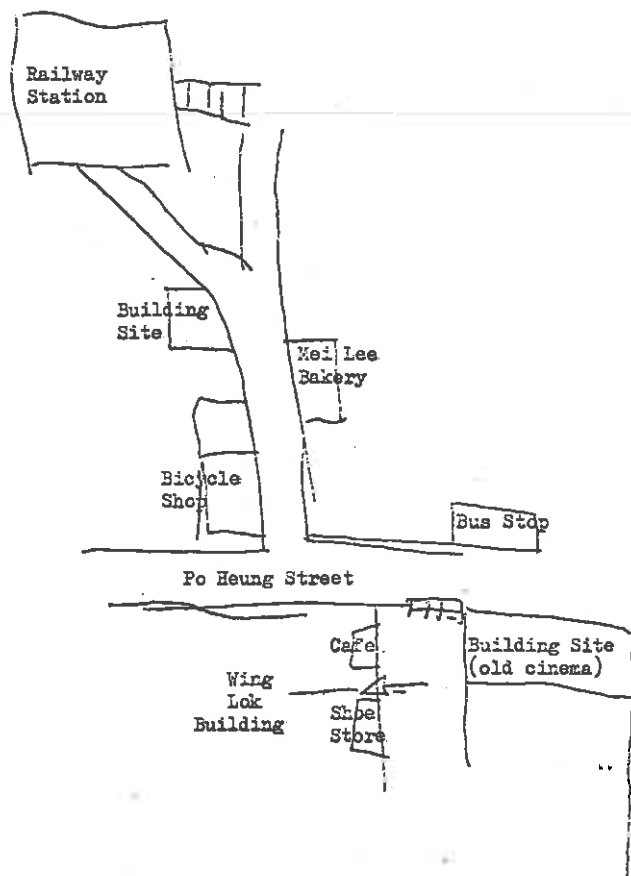Fig. 4(C) Spatial Map —— LINK

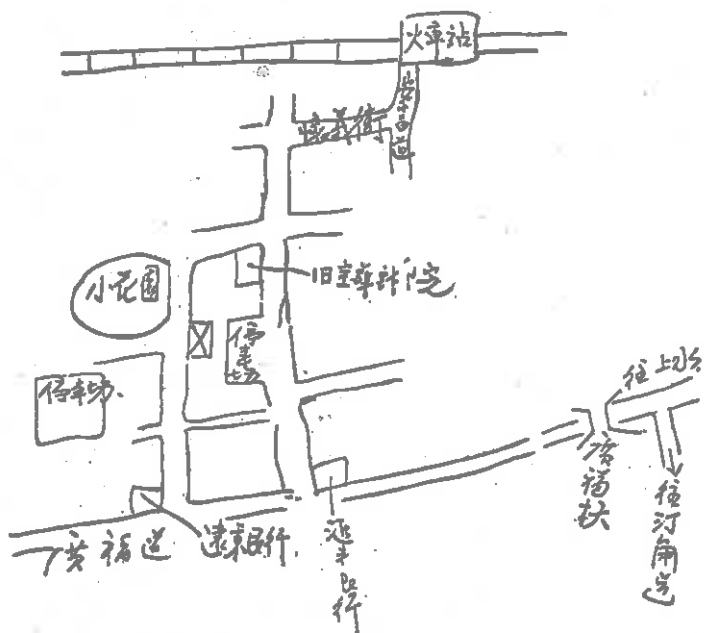Fig. 4(C) Spatial Map —— LINK
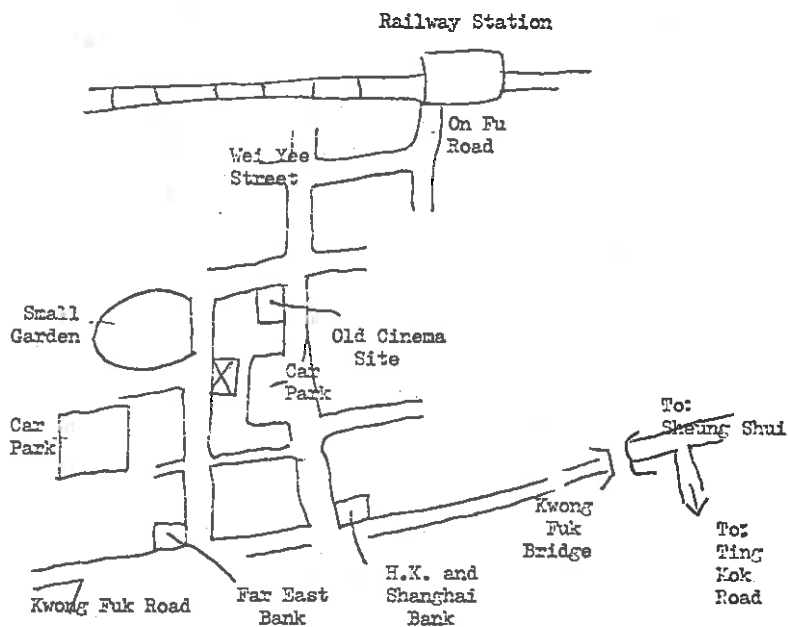
Fig. 4(D) Spatial Map —— PATTERN

Fig. 4(D) Spatial Map —— PATTERN

away from it.   The network map is more like a true mental road map with numerous cross linkages and inter-connections drawn in.   Each of these two map types accounts for 9% of the total.   In all these sequential maps, the emphasis is on paths and linkages, and very little information on districts and landmarks are put in.   The main description on the map is the naming of the streets.

The spatial maps account for only 16.5% of all maps.   This gives the impression that the residents of Tai Po seldom organise the town into a static series of districts and landmarks.   As a matter of fact, there are few landmarks and areas of activity concentration in Tai Po that might evoke a strong image on the residents.   Apart from the railway station, the most common reference points on the map are the places they usually visit — the restaurants, the banks and the bus stops, for example.   The crudest types of spatial maps are the scatter (Fig.4(A)) and the mosaic maps (Fig.4(B)). The scatter map involves just names distributed over the sheet of paper, lacking any drawn connections.   The mosaic map encloses districts or boundaries but is vague about location of point features and linkages.   These two together account for less than 5% of all maps.   The most common type of the spatial maps is the link map (Fig. 4(C)), representing 9.4% of all maps.   It is basically a mixed case between the sequential and spatial categories, with either point features or districts linked together by roads — the spatial form of organisation, however, remains dominant.   The most refined of the spatial type is the pattern map (Fig. 4(D)) in which a fairly complete mapping of features having areal rather than linear extent is included.   There are, however, only three maps that can be classified as belonging to this category.

Table 1 also shows the relationship between the map style categories and certain characteristics of the respondents.   If only the "total sequential" and "total spatial" columns are considered, there are no significant deviations of the respondent variables recordings from the population's average.   However, since each of these two broad categories contains a range of map types representing a range of cognitive abilities, a comparison of the eight map types and respondent variables is also given in Table 1. It can be seen that the data for sex, education, occupation, income and mode of transport all produce some significant deviations from the population average.   Females, the less educated people, the working class and the lower income groups all tend to favour the simpler types of maps, whether sequential or spatial.   On the other hand, the private car owners seem to be producing more of the better quality network and pattern maps.   In

order to test the statistical significance of the relationships between map types and the characteristics of the respondents, X^2 values are computed. The result, shown in Table 2, indicates that map styles are significantly related with sex, education, occupation and income. This seems to agree with most of the observations just made. On the other hand, age, length of residence and mode of transport have no significant relationship with map styles. This seems to reflect the point made earlier about the changing townscape of Tai Po and its effects on legibility.

Table 2.
Significance of Relationship Between
Map Styles and Respondent Variables
(Probability of X^2 values)

1. Age   Insignificant
2. Sex   Significant at p<.02
3. Education   Significant at p<.05
4. Occupation   Significant at p<.01
5. Income   Significant at p<.01
6. Length of Residence   Insignificant
7. Mode of Transport   Insignificant

Map Sophistication

As the sequential and spatial maps both include a range of map styles from topological to positional, an attempt will be made to re-group the maps according to their degree of sophistication. The two netted categories and the pattern map represent maps of a higher degree of sophistication, while the remaining five types are grouped as the less sophisticated maps. The former represents 20.5% and the latter 79.5% of all the maps. The high percentage of the less sophisticated maps is a reflection of the characteristics of both the residents and the town's development. Relationships between map sophistication and certain respondent variables are shown in Table 3 and the statistical significance between them are shown in Table 4.

It can be seen clearly that the relationships between map sophistication

Table 3: Map Sophistication and Respondent Variables (%)

		LESS SOPHISTICATED MAP	MORE SOPHISTICATED MAP	TOTAL
TOTAL	No.	101	26	127
	%	79.5	20.5	100.0
AGE	< 40	75.9	24.1	100.0
	≥40	85.4	14.6	100.0
SEX	M	73.2	26.8	100.0
	F	91.1	8.9	100.0
EDUCATION	NONE	100.0	−	100.0
	PRIMARY	95.0	5.0	100.0
	SECONDARY	78.6	21.4	100.0
	TERTIARY	63.0	37.0	100.0
OCCUPATION	UNEMPLOYED	93.1	6.9	100.0
	WORKING CLASS	97.4	2.6	100.0
	MIDDLE CLASS	61.7	38.3	100.0
INCOME (per month)	LOW <$1000	100.0	−	100.0
	MEDIUM $1000−$2500	84.7	15.3	100.0
	HIGH >$2500	67.9	32.1	100.0
LENGTH OF RESIDENCE	≤10 YRS	76.6	23.4	100.0
	>10 YRS	81.2	18.8	100.0
MODE OF TRANSPORT	WALKING	88.1	11.9	100.0
	PUBLIC TSPT	74.5	25.5	100.0
	PRIVATE CAR	66.7	33.3	100.0

and the respondent's sex, educational attainment, occupation and income are again statistically significant. The most significant relationship is, in fact, with occupation which agrees with the findings of Pocock in his Durham study that the majority of the middle class respondents produce more complex maps. In fact, occupation, income and educational attainment are in many ways related and it is not surprising to find that the better educated and the higher economic status groups are producing the more sophisticated maps. The difference in sex is also apparent with maps produced by males generally exhibiting a higher degree of sophistication. Age, length of residence and mode of transport do not show statistically significant relationship with map sophistication which again suggests a generally low legibility of the study area as a result of changing townscape and the lack of identity of elements.

Table 4.
Significance of Relationship Between
Map Sophistication and Respondent Variables
(Probability of X^2 values)

1. Age   Insignificant
2. Sex   Significant at $p < .05$
3. Education   Significant at $p < .02$
4. Occupation   Significant at $p < .01$
5. Income   Significant at $p < .01$
6. Length of Residence   Insignificant
7. Mode of Transport   Insignificant

Conclusion

The analysis of the mental maps of Tai Po as presented by its residents seems to confirm with a number of research findings in Western cities. However, as the present study is set in a different cultural, social and economic background, some major differences in the mental map styles and complexity are to be expected. One main observation is the large proportion of maps of low level of sophistication, whether sequential or spatial. Despite the relatively simple layout of the town, no respondent can produce a more coherent map of the whole area. The majority of the maps are confined to their immediate neighbourhoods, but with the arterial road and/or the railway line and station as the main features of reference. This may be due partly to the similarity, and thus the lack of identity,

of different sections of the town which means that few things outside one's neighbourhood can conjure a particularly strong image. At the same time, lacking a well-defined town centre, there are few areas within the town that might produce a large concentration of activities. There are no large shopping centres, no community centres and no cinemas (all demolished during the process of reconstruction). Furthermore, the amount of employment opportunities within the town is limited, resulting in the majority of the residents having to commute out of the town every day. Commuting, however, is not necessary for a large number of small-scale local commercial and industrial undertakings where business and residence are found in the same premises. It is, therefore, not surprising to find that the spatial behaviour of many people are confined only to limited sections of the town. Their mental images of the environment are thus restricted.

When the results of the present study is compared with similar works done in other countries, a number of common findings can be identified. There is an overall tendency for the maps to belong to the sequential type, as evidenced by the studies of Appleyard (1969), Goodchild (1974), Spencer and Llyod (1974) and Pocock (1976). This agrees with the ideas of Lynch that urban images are largely path-oriented. Of course, the importance of the sequential elements will vary according to the instructions set by the researcher, and the layout and functional characteristics of the city. However, it is still fair to conclude that all these studies seem to suggest that the image of the city is derived largely by the resident's own movement experience, i.e. it is largely a by-product of his spatial behaviour.

The results of this study also conform with most other findings in that age has little relationship to map styles or sophistication. There is also agreement on the difference in map sophistication between the sexes. Females are found to be producing the less sophisticated types of sequential and spatial maps. This, coupled with the large percentage of females who refused to draw the mental maps in the first instance (about 60%), are clearly in congruence with the ideas of Appleyard and Pocock in that map-drawing ability may be considered an unfeminine quality. It may suggest that mental mapping is not a satisfactory method of extracting information about the environment from the majority of the female population.

There seems to be a general agreement indicating the importance of

the related factors of education, occupation and income level in affecting people's perception of the environment. In the present study, both the map styles and the degree of map sophistication are strongly related to the above factors. The less educated, working class people usually organise their images solely on the basis of their own concrete subjective experiences and little logical inference is employed in constructing the maps: e.g. grid-iron street patterns would be generalised as a series of isolated turn-offs from the main artery. On the other hand, the better educated and higher income groups tend to make inference from an abstract model of "the way cities are" even when they have relatively little concrete experience with the city. They would infer larger spatial patterns as yet unexperienced from small physical cues, and as a result, they tend to be capable of producing more netted and patterned maps. Indeed, there is strong evidence to indicate that people from various socio-economic classes do perceive their environment differently. It is in this context that people like the town planners, who may have a socio-economic background different from that of the residents, should be aware of these facts and to give due considerations to the difference in the way they and the residents would perceive the environment of the city.

The length of residence in a city would intuitively imply a difference in the degree of familiarity with the place. Although temporal familiarity has been found to be important in map styles and/or map sophistication in other studies, there seems to be little indication of such relationship in the present study. It is probably because most of the developments in Tai Po dated back only to the beginning of the present decade. The indigenous population which have stayed in the area for a long time do not necessarily gain a greater degree of familiarity with the town than the newcomers.

As for the mode of transport, Appleyard has found a difference in map types between bus-only travellers and car-only travellers, the former being usually unable to draw a coherent city map; while the latter more often present the city as a coherent and continuous system. Although the relationship in Tai Po has not been found to be particularly significant statistically, there are strong indications from Tables 1 and 3 that car drivers usually produce a greater proportion of the netted and patterned maps because of the constant attention required in driving a car in contrast

to the passive travel experience gained on public transport.

Methodologically, mental map still provides a useful source of information about an individual's perception of the environment. It does allow an understanding not only of the way in which people structure their city but also of the imageability and legibility of environmental elements within the city. It is probably not necessary to have an uniform set of map style categories for universal application. However, the identification of the mental map elements and the way that they are being organised in the minds of the spatial actors provide the basis for comparative studies. Despite the fact that the mapping exercise may be affected by the skill of the respondent in making a cartographic representation, mental maps are efficient means of producing a coherent picture of the image of the environment. It allows the respondent to knit together disparate pieces of information into some interrelated form. Maps in the minds of people can now be considered in the same way as modern cartography which shows an increasing concern for the map as a medium of communication rather than as a storage medium for spatial data (Robinson, 1977). An understanding of these points may obviate the criticism that mental maps are too elusive an idea.

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