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Michael R. Hill
University of Nebraska-Lincoln, michaelhilltemporary1@yahoo.com

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STALKING THE URBAN PEDESTRIAN
A Comparison of Questionnaire and Tracking Methodologies for Behavioral Mapping in Large-Scale Environments

MICHAEL R. HILL *received his Ph.D in geography from the University of Nebraska—Lincoln and is currently completing a second doctorate in sociology. He was formerly Acting Assistant Dean in the College of Design at Iowa State University and Assistant Professor of Community and Regional Planning. He edited a special issue of* Man-Environment Systems *on pedestrians (1981). He is the author of a forthcoming University of Nebraska Studies monograph,* Walking, Crossing Streets, and Choosing Pedestrian Routes. *His current work is focused on design theory and epistemology, the experience of recent doctorates in academia, and the sociology of the visual arts.*

ABSTRACT: Behavioral mapping in unrestricted, outdoor environments raises methodological challenges which have led several environmental behavior researchers to employ questionnaires rather than behavioral observation as the usual method of data collection. This study provides an empirically-grounded comparison of both techniques for recovering data on routes selected by pedestrians as they engage in unrestricted travel from place to place in an urban environment. Mid-trip interception tracking provides expensive but accurate data on partial trips whereas questionnaires provide more easily obtainable data on complete trips but with a lesser degree of accuracy. The reduced level of accuracy for questionnaire data is mild, however, and may be tolerable given the specific aims and resources of a particular investigation.

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Behavioral mapping in unrestricted, outdoor environments raises methodological challenges that have led several environmental behavior researchers to employ questionnaires rather than behavioral observation as the usual method of data collection. Ittelson, Rivlin, and Proshansky (1970: 659) originally conceived of "behavioral maps" as descriptions of "observed behavior". Compared with full-scale, city-wide urban environments, however, direct observation is relatively less difficult to accomplish within the controlled and well-defined confines of the psychiatric ward setting chosen by Ittelson and his colleagues to illustrate their technique. Nonetheless, the conceptual and empirical richness of behavioral mapping has attracted several researchers who are interested in the spatial behavior of pedestrians in largely uncontrolled, citywide environments. The difficult logistics of direct observation in full-scale urban settings, however, have led most researchers to opt for questionnaire survey techniques rather than direct observation. For studies of human spatial behavior in large-scale environments such as entire cities, the observational tradition of the ethological movement has been shelved in favor of sociological survey techniques.

Survey and direct observation methodologies both possess advantages and drawbacks; yet, they have not been systematically compared with reference to data gathering efficiency or accuracy when used to recover data for behavioral mapping in large-scale environments. Previous studies of city-wide pedestrian behavior are based primarily on questionnaire data and therefore rest on an unsupported assumption concerning the adequacy of questionnaires to recover data useful to behavioral mapping projects. Thus, this study offers an empirically-grounded comparison of both techniques for recovering data on routes selected by pedestrians as they engage in naturally occurring, unrestricted travel from place to place in an outdoor urban environment.

In order to compare these techniques, 200 randomly selected, spatially stratified pedestrians were intercepted

midtrip and unobtrusively tracked to their destinations and thereupon presented with questionnaires asking them to describe the spatial structure of the walking trips they had just completed. This procedure provides a mechanism for contrasting an observer's objective record of a trip with a respondent's subjective recollection of the same trip. Before exploring the details and implications of this project, however, previous studies of pedestrians using questionnaire and tracking techniques are briefly reviewed.

PREVIOUS TRACKING STUDIES

Tracking was first used to study pedestrian movement by Weiss and Boutourline (1962) who accompanied visitors to a World's Fair. Their data were trip logs in which observed movements and locations were noted together with a record of when each movement event took place. Weiss and Boutourline proposed that an *obtrusive* observer does not affect the behavior of the subject. Although Weiss and Boutourline failed to adequately assess the obtrusive aspects of their research design, Bechtel's (1967) study of movement behavior in museums provided a sound indication of possible "observer effects." Bechtel found that museum visitors who knew they were taking part in an experimental study exhibited much different movement behaviors than did the visitors who were unaware that their movements were being recorded. Recent studies of pedestrian jaywalking behavior (e.g., Russell et al., 1976; Hill and Roemer, 1977) indicate that human behavior changes when an individual feels that he/she is under the watchful eye of an observer.

An early example of *unobtrusive* tracking is found in Winkel and Sasanoff's (1966) study of visitor behavior in Seattle's Museum of History and Industry. They sought to provide an empirical benchmark against which to test a photographic simulation study of visitor behavior. In track-

ing each subject from place to place, they employed the following guidelines:

> At all times the tracker attempted to remain inconspicuous. It was found that observation at an appropriate distance allowed the preservation of an anonymity consistent with careful data collecting [1966: 622].

Tracking involved recording the subject's movement by drawing a line corresponding to the subject's observed movement on a base map of the museum. Except that it is expanded beyond the museum walls to embrace the urban environment as a whole, essentially the same methodology is adopted in the present study and was pretested in an earlier pilot study (Hill, 1978). It is possible to make observations from as much as one to two blocks away and from the side of the street opposite to the one on which the subject is walking. In crowded conditions, the observer must move closer to the subject, but the crowd itself masks the presence of the observer.

Tracking a pedestrian's route through an urban area generally requires that the observer actually follow the subject on foot. Technologically sophisticated approaches such as remote sensing (e.g., Lautso and Murole, 1974; Pushkarev and Zupan, 1975) may be appropriate for estimating pedestrian volumes on given streets, but are far too coarse for determining specific routes followed by specific individuals. Garbrecht (1971) used a fixed observation post in a tall building to observe pedestrian route selection through an office parking lot. Although effective for exploring behavior in restricted spatial settings, this "eye in the sky" approach fails as soon as the pedestrian walks beyond the limits of the observer's lines of sight. The same limitation applies to most other fixed observer studies that recently have employed time-lapse photography and video recording techniques. In short, unobtrusive tracking in which an observer follows (or "shadows") a subject on foot appears to have considerable validity as an information-gathering

technique for learning the exact routes taken by pedestrians in urban environments. It is also very time-consuming and for this reason many researchers have turned to questionnaires.

PREVIOUS QUESTIONNAIRE STUDIES

Questionnaire survey techniques have also been employed to gather data on pedestrian route choices. Both Hartenstein and Iblher (1967) and Marchand (1974) used questionnaires to recover detailed data on individual route choices. In both studies, however, these detailed data were subsequently aggregated into flow maps that masked individual routes. Blivice (1974) focused more directly on the problem of route selection and also employed questionnaires to collect his data. The questionnaire remains the primary data collection technique used in most national surveys of modal split and other transportation issues. In short, most everything known about pedestrian route selection in particular and pedestrian mode choice in general derives from survey questionnaires. Until the present study, there had been no attempt to corroborate observationally the accuracy of questionnaire-based data on pedestrian route choices.

STUDY SITE AND SELECTION OF INTERCEPTION POINTS

In order to compare the questionnaire and tracking data collection techniques, twenty random, spatially stratified quadrats (0.38 square mile each) were selected within the contiguous built-up area of Lincoln, Nebraska. Each quadrat represented a relatively dense street network and contained from 16 to 34 street intersections. Within each quadrat, five intersections were randomly selected and identified as "interception points." The procedure resulted in a total of one hundred sample points.

TRACKING PROCEDURE

A quadrat for each day's observation was randomly selected, as was the order in which interception points within the quadrat were visited to begin tracking. When the observer arrived at an interception point, he positioned himself so that he could observe the intersection as inconspicuously as possible and then time a three-minute "clearing period." Following this period, the observer tracked the first unaccompanied individual who either stepped into the street intersection or rounded a corner at the intersection. A standard data recording form was used for noting all observed information.[1]

Certain classes of pedestrians were exempted from observation: (1) those who appeared to have a regular route to follow as part of a job, e.g., mail carriers, police officers, paper carriers, and so on, (2) those who had been previously observed as subjects, and (3) any who were personally known to the observer. Eight observations were initiated but then terminated when subjects looked backwards more than once in the direction of the researcher. In these cases, it was suspected that the subject might have concluded that he or she was being followed or observed.

An important practical and theoretical issue concerns when a given observation should be considered "completed". This was handled pragmatically. Observation was terminated when the subject remained in one location for a period of ten minutes or longer. This rule is arbitrary but any decision that a "destination" has been reached is always in some sense arbitrary. Adoption of the "ten-minute" rule had the practical consequence of allowing the researcher to complete many more observations per day than if, for example, a one-hour waiting period had been used. In total, two hundred tracking observations (ten in each quadrat) were completed. The shortest trip observed was .03 mile whereas the longest was 2.5 miles. The average trip was approximately .35 mile. Duration of the shortest observed trips was less than one minute, and the longest observation

took one hour and 20 minutes to complete. The average trip was accomplished by the tracked pedestrians in approximately seven minutes.

QUSTIONNAIRE PROCEDURE

When one of the above tracking observations reached "completion" using the "ten-minute" rule, the researcher then approached the subject, identified himself, and requested the subject to complete and return a questionnaire. The researcher dressed in light colors, attempted to approach subjects with a friendly smile on his face, and wore a bright red name tag which bore the researcher's name and the legend: "Lincoln Pedestrian Study". Introduction was aided by quickly presenting the subject with a small business-type card that gave the researcher's name, affiliation, and telephone number. The subject was then handed: (1) an information folder describing the project, (2) a questionnaire, (3) a stamped, preaddressed envelope, and (4) a sharpened pencil. Each questionnaire[2] contained eight questions including an item which asked respondents to:

> Describe the street route you took to get from the start to the end of the walking trip you just completed. Just pretend you are writing directions so that a friend visiting from another town could follow the route you took. You may not be able to remember *exactly* what your route was, but try to be as accurate as you can. It may be easiest to just draw a little map of your route. Be sure to indicate the names of the streets.

A space measuring 4 1/2 by 7 inches was provided on the questionnaire for the respondent's answer.

Of the 200 subjects who were tracked, 158 accepted questionnaires. Nine refused to accept a questionnaire while 42 subjects could not be located at the end of the ten-minute period that determined the completion of the tracking observation. "Losing" a subject most often oc-

curred when a subject entered a large, crowded department store, cavernous office building, or extensive apartment complex. When the researcher lost contact with a subject in a large building, he waited near the main entrance/exit for a period of ten minutes. If the subject did not reappear, the tracking observation was deemed "completed" although it was not possible to locate the subject for the purpose of delivering a questionnaire.

Subjects were urged to complete and return the questionnaires by mail at their earliest convenience. Each questionnaire was coded inconspicuously with a number that tied it to the associated tracking observation. Questionnaire return rate was 97 (61%) out of 158 distributed. 90% of the 97 completed questionnaires were returned within a week and over half were placed in the mail the day following distribution. Comparison of the 158 subjects who accepted questionnaires with the 42 who could not be located or who refused showed no statistical differences (.05 level) on the dimensions of observed trip length, trip complexity, walking velocity, or observer-estimated age and gender. Further, using the same comparative dimensions, those who accepted but failed to return questionnaires were not significantly different (.05 level) from those who did return questionnaires.

RESULTS

Of the 97 subjects who returned questionnaires, 95 (98%) responded to the request to provide a detailed description or diagram of the route they had just finished walking. Unknown to these subjects, however, at least the final portions of their trips had actually been observed and recorded by unobtrusive tracking. A method thus became available for checking the accuracy of the subjects' self-reports.

Subjects generally described their trips accurately: 83 (87%) of the 95 subjects who answered the route description

request gave accurate descriptions of those portions of their trips that could be corroborated from observational data. A subject's response was judged "accurate" if it revealed the exact street route to have been taken, including all turns (if any) and correct street identification (either by name, number, geometry, or identifying landmarks). Conversely, a subject's response was considered "inaccurate" if he or she made only a relatively minor descriptive error such as being one block off in indicating the intersection where an observed midtrip direction change took place. The majority of "inaccuracies" were of this minor type. A few subjects, however, provided descriptions that had no discernable relationship to the trips observed by the researcher. Such major inaccuracies may have resulted more from failure to make the questionnaire fully comprehensible to all subjects rather than from any inherent defect in the spatial recall abilities of the subjects whose responses contained major discrepancies. On the whole, however, inaccurate replies, whether major or minor in character, were relatively infrequent.

Only twelve subjects (13%) provided inaccurate trip descriptions. The source of these inaccuracies cannot be determined here, but a few possibilities may be noted. It is observed in passing that slightly more women gave inaccurate descriptions than men, that inaccurate descriptions were slightly more common as the length and structural complexity (i.e., incorporating more changes in direction) of trips increased, and that older pedestrians supplied slightly less accurate responses than younger ones. None of these relationships were statistically significant at the .05 level, however. A larger sample of inaccurate responses together with more powerful statistical tests clearly would be useful to a more specific examination of the possible effects, if any, of age, gender, trip length, and route complexity on recall accuracy.

Additional sources of inaccurate responses should also be noted, although the data collected here do not permit

even a speculative investigation of these possibilities. "Wrong" answers may have resulted from an idiosyncratic inability on the part of a subject to write a coherent verbal description or to draw graphic images such as maps or diagrams. Other "errors" might be attributed to subject memory lapse. Possibly misunderstanding the questionnaire instructions (or due to delay in completing the questionnaire), some subjects may have reported a trip accurately but not the specific trip that had been tracked. Finally, the researcher may have made errors in recording the tracking data.

Despite the many possible sources of errors, the small percentage of inaccurate responses found in this study speaks well for the spatial recall abilities of the pedestrians who participated unknowingly in this investigation. Divergence between observed and reported behavior may be more marked in other settings or when far more complex behaviors are examined. Nonetheless, the small number of inaccurate replies received in this study supports the general efficacy of questionnaire methodologies for studying route selection by pedestrians in urban areas.

Further, those subjects who responded with accurate descriptions of the terminal, intercepted segments of their routes quite possibly provided accurate descriptions of their entire trips, including those portions completed prior to the start of tracking observations. It can be argued against this assertion that the subjects may have been better able to recall the latter portions of their trips (the observationally corroborated segments) than the earlier parts (which were not generally corroborated). However, many of the corroborated portions encompassed nearly entire trips (having been intercepted very near the actual point of trip origin reported by the subject). There were, in fact, 22 cases (27%) in which the tracked trip was, for all practical purposes, identical to the total trip reported by the subject. Thus, there is at least minimal reason to believe that those who reported accurately on the terminal segment of their trip also reported accurately on the unobserved, inaugural portion of their trip as well.

DISCUSSION

This study demonstrates that questionnaire techniques may be used to collect pedestrian route selection data when the researcher is willing to accept a degree of error in his or her results. Approximately 13% of the pedestrians who returned questionnaires in Lincoln, Nebraska, recalled their trips inaccurately. The acceptability of this degree of error by other researchers will, quite possibly, depend on the resources available to them when they are planning research designs. Questionnaires can be distributed quickly and cheaply. Tracking observations, on the other hand, are time-consuming and can take a considerable physical toll on the researcher. A city-wide tracking study should not be undertaken lightly or without careful consideration of alternative techniques. Further, the "interception" method used in this study leaves the inaugural portion of each trip unobserved. Tracking "complete" trips from start to finish requires the even more time-consuming procedure of staking-out specific pedestrian generators that, although not especially difficult in central business districts, for example, is exceptionally time-consuming in residential areas. The researcher may wait for several hours before a subject emerges from a home only to find that the subject is walking a few feet to a parked car. In summary, it is hoped that this study sheds new light on the accuracy of previous questionnaire-based studies of pedestrian route selection and also provides future researchers with greater insight into the comparative efficacy and accuracy of two important data collecting techniques in environmental design research.

NOTES

1. Copies of the data collecting form are available from the author by sending a request and a self-addressed, stamped envelope.
2. Copies of the questionnaire are available from the author by sending a request and a self-addressed, stamped envelope.

REFERENCES

BECHTEL, R. (1967), "Human movement in architecture," pp. 642-645 in H. M. Proshansky et al., (eds.) Environmental Psychology. New York: Holt, Rinehart & Winston, 1970.

BLIVICE, S. (1974), Pedestrian Route Choice: A Study of Walking to Work in Munich. Ph.D. dissertation, University of Michigan.

GARBRECHT, D. (1971), "Pedestrian paths through a uniform environment," Town Planning Review, 41, 1 (January): 71-84.

HARTENSTEIN, W. and H. R. IBLHER (1967), "Visitors' records: a method for analyzing the flow of people in the C.B.D.," pp. 497-502 in University of Amsterdam Sociological Department (eds.) Urban Core and Inner City. Leiden: E.J. Brill.

HILL, M. R. (Forthcoming) "Walking straight home from school: pedestrian route choice by young children." Transportation Research Record.

———(Forthcoming) Walking, Crossing Streets, and Choosing Pedestrian Routes: A Survey of Recent Insights from the Social/Behavioral Sciences. University of Nebraska Studies, new series no. 66. Lincoln: Univ. of Nebraska—Lincoln.

———(1978)"Pedestrians, priorities, and spatial games," pp. 126-136 in S. Weidemann and J. R. Anderson (eds.) Priorities for Environmental Design Research. Washington, DC: Environmental Design Research Association.

——— and T. T. ROEMER (1977), "Toward an explanation of jaywalking behavior: a linear regression approach." Man-Environment Systems 7: 342-349.

ITTELSON, W. H., L. G. RIVLIN, and H. M. PROSHANSKY (1970), "The use of behavioral maps in environmental psychology," pp. 658-668 in H. M. Proshansky, et al., (eds.), Environmental Psychology. New York: Holt, Rinehart & Winston, 1970.

LAUTSO, K. and P. MUROLE (1974), "Study of pedestrian traffic in Helsinki: methods and results." Traffic Engineering and Control 15, 9: 446-449.

MARCHAND, B. (1974), "Pedestrian traffic planning and the perception of the urban environment: a French example." Environment and Planning (Series A) 6: 491-507.

PUSHKAREV, B. S. and J. M. ZUPAN (1975) Urban Space for Pedestrians. Cambridge, MA: MIT Press.

RUSSELL, J. et al. (1976), "Informational properties of jaywalking models as determinants of imitated jaywalking: An extension to model, sex, race, and number." Sociometry 39, No. 3 (September): 270-273.

WEISS, R. and S. BOUTOURLINE (1962), Fairs, Exhibits, Pavilions and Their Audiences. (mimeo)

WINKEL, G. and R. SASANOFF (1966), "An approach to an objective analysis of behavior in architectural space," pp. 619-631 in H. M. Proshansky, et al., (eds.), Environmental Psychology. New York: Holt, Rinehart & Winston, 1970.