THE RELATIVE EFFECTIVENESS OF DENSITY-RELATED MEASURES FOR PREDICTING ATTITUDES AND BEHAVIORAL VARIABLES[1]

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Over the past decade the social science literature has contained with increasing regularity reports of studies which deal entirely or in part with the effects of population density on human behavior and attitudes. While numerous studies have based their measures of population density on census or other aggregate data, others have considered the size of place of residence as a measure of how close people live to each other. In other words, lacking the means of obtaining an objective measure of how close people live together, many researchers have used size of place as a surrogate measure of residential density. In order to see if, in fact, size of place is a reliable measure of residential density, this paper will consider the relationship of size of place to the most objective density measure we could obtain - the actual number of dwellings per given unit of land. Next, less objective density-related measures which are easier to obtain will be considered in relation to our objective density measure. Finally, in an exploratory effort, we will examine the relative effects of each of our measures in predicting density-related dependent variables.

Background and Methodology

Prior to discussing relationships among our density-related measures and their relative effect in predicting two responses, a brief discussion of the sources of data including the procedures used in obtaining density measures is in order.

In the fall of 1971, approximately 1300 interviews were taken with the heads of a sample of households throughout the United States. The survey was one of a series conducted quarterly by the Survey Research Center and included several questions dealing with the respondents' recreation behavior and residential environment.

Types of Questions

With respect to recreation behavior, respondents were asked several questions about their level of participation in a number of outdoor activities. One question dealt with family participation in hunting or fishing, activities thought to be more closely associated with people living in small towns, rural or other sparsley populated areas.

Among the questions related to the residential environment, respondents were asked to assess their immediate neighborhoods on several semantic differential type dimensions. Three of these (attractive-unattractive, pleasant-unpleasant, great place to live-poor place to live) were used to create a general scale of neighborhood satisfaction. Another specific dimension which the respondent assessed was the extent to which he viewed the neighborhood as crowded. Although it can be argued that subjective assessments of neighborhood crowding should, by their very nature, be correlated with neighborhood satisfaction measures, crowding was intentionally omitted as an item in our satisfaction scale. Our intent was, first, to see its relative importance among a number of subjective assessments of specific neighborhood attributes and second, to see how crowding relates to an objective measure of density. With considerable discussion in the literature as to whether "crowding" and "density" are interchangeable terms, (Stokels, 1972; Hawley, 1972), the analysis in this paper will enable us to see if, in fact, these two variables can be substituted for one another.[2]

Interviewer Observations

In addition to conducting interviews with the respondents, interviewers were asked to assess a number of characteristics of the respondents' dwellings and the area around it. While interviewers have identified type of structure and land use in the surrounding area in previous studies, we know of no attempts to have interviewers assess the extent to which the immediate environment around the respondents dwelling was built up. In an exploratory effort, interviewers in this survey were asked to make a judgement about the amount of open space around the respondent's dwelling. Specifically, they were asked,

> Is the area that can be seen within 100 feet of the front door of the dwelling (or 100 feet of the front door of the building in which the respondents' dwelling is located) best described as:
>
> 1. Entirely built up with buildings, no open space present except that associated with privately owned buildings.
> 2. Mostly built up with buildings; some open space present such as parks, school yards, open fields, vacant lots, body of water, etc.
> 3. Sparsely built up with buildings; mostly open space present such as parks, school yards, open fields, vacant lots, bodies of water, etc.
> 4. All open space; respondent's dwelling is the only building within the area.

To date, little effort has been made to check the reliability of our interviewer's assessments. Nevertheless, we feel this variable may offer another measure of how close people live to each other. Subsequent work with this item in predicting to a number of attitudes and behaviors should reveal its relative importance as a variable.

Objective Density Measure

While the respondent's perception of crowding and the interviewer's assessment of open space are relatively inexpensive measures for any survey, measures of the actual density at which people in a sample live are more difficult and costly to obtain, particularly when the sample of households is distributed among four hundred and sixty-five (465) locations throughout the United States. Within the context of a methodological study, a procedure and cost estimates were developed for

measuring residential density for clusters of households falling in our national sample.[3] In developing this work, residential density was defined as the number of households within a geographic area known as the "micro-neighborhood". Operationally, a micro-neighborhood includes the structure containing the respondent's dwelling and the five or six dwellings or buildings that can be seen from the respondent's dwelling entrance or from the entrance of the building within which the respondent lives. It should be remembered that this closely approximates the environment that the respondent and the interviewer were asked to assess as to the extent of crowding and open space, respectively.

For our calculation of actual density, we had hoped to follow a procedure similar to that used in a study of planned residential environments (Lansing, Marans and Zehner, 1970). Briefly, this procedure involved the use of a transparent grid of a 2-acre square which would be used in conjunction with scaled maps or aerial photographs containing buildings and dwelling units falling in our sample. The number of dwellings within a square would be counted and divided by two in order to get a measure of the number of dwellings per acre for any cluster of dwellings.[4] Unfortunately, detailed maps or photographs were not available for the 465 clusters of dwellings in our national sample. We viewed the time and cost involved in obtaining them as prohibitive. Instead, we relied on "sketch maps" prepared by our interviewers in enumerating dwellings and blocks for sampling purposes. These "sketch maps" contained block outlines, structures and the number of dwellings in each structure if it were devoted to residential use. In some instances, other physical features such as railroad lines, rivers and streams were shown. If these "sketch maps" had been drawn with consistent accuracy and to a specified scale, our task of measuring the land area within which our sample dwellings were situated would have been easy. However, in many instances, structures were not accurately located on the map nor were maps drawn to a specified scale. Furthermore, structures which may have existed across the street from the sample dwellings were not shown. With these limitations, our measurements were not as precise as we had wanted. Nevertheless, we were able to make reasonably accurate estimates of land area based on a set of definitional criteria and reference maps covering all our sample points. These were either census tract maps, highway department or road commission maps, U.S.G.S. maps or other maps available from local planning agencies. We are now in the process of validating our measures by obtaining and using aerial photos and detailed plat maps covering a number of sample sites.[5]

After completing our calculations of density for each sample cluster, these values were assigned to each dwelling within the cluster. Seven density classifications were created ranging from "less than one DU per acre" to "40 DU's per acre and over" with the modal category being 1 to 3 DU's per acre.[6]

We have developed an operational procedure for determining residential densities for small areas within the framework of national samples. Although these measures are not precise, we believe they are sufficiently accurate and can be used in studies where residential density is considered to be an important explanatory variable. The procedure for obtaining the density measure, however, is both expensive and time consuming. A basic question is whether the cost is warranted based on the benefits derived from having this objective density measure.

Correlations Between Objective Density and Other Measures

Thus far, we have discussed four of the density measures used in this paper. Ranging in order from the most objective to the most subjective, they are: the objective density measure, size of place, interviewer's assessment of open space and respondent's perception of crowding. A fifth measure, urbanicity, was added as a possible improvement over the traditional size of place measure. Like size of place, urbanicity can be easily obtained from existing data, but it has a more detailed set of ordered classes ranging from central cities to rural areas.

As we indicated earlier, one objective of this paper is to consider the relationship between the objective density measure and size of place of residence, a measure which has often been used to approximate population density. The product-moment correlation shown in Table 1 suggests

Table 1

Product-Movement Correlations Between Objective Density Measures and Other Density-Related Variables

	Objective Density Measure
Size of place of residence	.70
Urbanicity Scale	.72
Interviewer's assessment of open space	.47
Respondent's perception of crowding	.47

that the relationship between these variables is fairly strong (r = .70). With urbanicity, the product-moment correlation is only slightly stronger than that between density and size of place.[7] While these relationships are fairly strong, the question remains whether either of these variables representing the urban-rural continuum is a good substitute measure for actual density when predicting attitudes and behaviors. In the next section of this paper we will attempt to shed additional light on this question when we consider the marginal contributions of each of these variables in two regression analyses.

The extent to which our two less objective density-related measures are related to the objective density measure are also shown in Table 1. The product-moment correlations between the interviewers' assessment of open space and density and the respondents' perception of crowding and density are identical (r = .47). However, these relationships are not as strong as the relation-

ships between the density measure and size of place and urbanicity. As a result of these correlation analyses, we can tentatively conclude that, within the context of national samples, size of place (or urbanicity) may be appropriate substitute measures for residential density. Furthermore, the interviewer assessment of open space and the respondents' perceptions of crowding do not appear to be appropriate substitutes for actual residential density. In fact, they may be measuring other dimensions of density to which people will respond.

Multivariate Analysis

To find out if size of place (or urbanicity) are appropriate substitutes for the objective density measure and if interviewer assessments and respondents' perceptions are measuring other dimensions of density, we considered two series of regression analyses - ones with the respondents' level of satisfaction with the neighborhood as a dependent variable and the other with an observable behavior - whether the family participates in hunting and fishing.

Satisfaction with Neighborhood

In the analysis of neighborhood satisfaction, several multiple classification analyses were run. We included in each equation a base set of independent variables -- housing type, income, race, life cycle and education. The first equation included only these variables. In subsequent equations we added to the base set of independent variables each density-related variable, one at a time, to observe its marginal effects. Table 2 shows the results of adding each of our five density-related measures to the base set of predictors. In the equation predicting to neighborhood satisfaction using only the base set of predictors, 20.6 percent of the total variance is explained. When adding the objective density measure the proportion of variance explained increases to 23.2 percent with a partial R^2 of 2.6 percent. Similarly, the additions of size of place, urbanicity, and the interviewers assessment of open space produce partial R^2's ranging from 2.6 to 2.9 percent.[7] However, when the respondents' perception of crowding is added to the base set of predictors, the proportion of variance explained is 34.0 percent, an increase of 13.4 percent. While it appears that the objective density measure and the interviewers' assessment of open space are no more useful in predicting peoples' satisfaction with their neighborhoods than the size of place (or the urbanicity) measure, their perception of crowding, contributes much more to the proportion of variance explained than the other measures.

Table 2

Determinants of Neighborhood Satisfaction

Independent Variables	R^2	Partial R^2
Base Set (Income, Education, Race, Life Cycle, Housing Type)	20.6	---
Base Set, Objective Density	23.6	2.6
Base Set, Size of Place	23.2	2.6
Base Set, Urbanicity	23.4	2.8
Base Set, Interviewer's Assessment of Open Space	23.5	2.9
Base Set, Respondent's Perception of Crowding	34.0	13.4

Participation in Hunting and Fishing

Having tested the various density measures as predictors of a subjective variable -- namely the respondent's satisfaction with his neighborhood -- we next tested the measures against a more objective dependent variable, the family's participation in hunting and fishing. This variable was chosen because it is observable behavior which has been found to be strongly related to a correlate of density -- size of place (Mandell and Marans, 1972).

First, we regressed a dummy variable indicating whether the family participates in hunting or fishing against the most important non-density related independent variables, namely income, education and age. Together, this base set of variables explained 10.3 percent of the total variance.

Table 3 summarizes the results of adding each of the five density measures to the base set of independent variables in order to see the marginal effects of each. Again, as in the prediction of neighborhood satisfaction, the objective density measure does not appear to be more useful in predicting the family's proclivity to hunt or fish than the urbanicity or size of place variables. However, all three of these more objective measures predict much better than the more subjective measures of the interviewer or the respondent.

Table 3

Determinants of Hunting and Fishing

Independent Variables	R^2	Partial R^2
Income, Education Age	10.3	---
Income, Education, Age, Objective Density	15.0	4.7
Income, Education, Age, Size of Place	14.0	3.7
Income, Education, Age, Urbanicity	15.2	4.9
Income, Education, Age, Interviewer Assessment of Open Space	12.0	1.7
Income, Education, Age, Respondents' Perception of Crowding	10.9	0.6

Summary and Conclusions

In this paper we have considered the relationship of residential density as an objective measure of how close people live to each other and size of place of residence - an often used surrogate density measure. We have also investigated relationships between the objective density measure and the assessments and perceptions of

interviewers and respondents. Methods and procedures for obtaining data from a national sample of households were discussed along with their relative costs. Analyses of two dependent variables -- satisfaction with neighborhood and participation in hunting and fishing -- were presented showing the relative value of each density-related variable as a predictor.

As a result of these analyses, a number of conclusions can be drawn. First, size of place of residence and urbanicity are much better proxies for our objective density measure than the interviewer's assessment of open space or the respondents' perception of crowding. Second, these more subjective measures (interviewer open space assessment and respondent perception of crowding) appear to be measuring things other than density per se. This finding with respect to crowding tends to support the notion that the psychological experience should be distinguished from the physical condition of density. Third, the traditionally used size of place of residence seems to be as good a measure as the urbanicity measure consisting of a more detailed and ordered set of classes. Finally, after controlling for a number of socioeconomic and demographic variables, the objective density measure does not appear to be better than size of place of residence in predicting density-related dependent variables.

APPENDIX A

CONSTRUCTED VARIABLES

Size of Place (1960 Census Classification)

1. Central cities of 12 largest SMSA's (including Consolidated Areas)
2. Cities of 50,000 and over, exclusive of (1)
3. Urban Places, 10,000-49,999
4. Urban places 2,500-9,999 and other urbanized areas not included in above codes
5. Rural, in an SMSA psu
6. Rural, not in an SMSA psu

Urbanicity

1. Central cities of 12 largest SMSA's (exclude Long Beach and Jersey City)
2. Cities with population (1960) of over 100,000 excluding those coded 1 in this variable
3. Suburbs, population (1960) 2,500 to 100,000 within the twelve largest SMSA's
4. Cities with population (1960) of 10,000 to 100,000, excluding those coded 3
5. Places with population (1960) of 2,500 to 10,000 excluding those coded 3
6. Rural places (population of less than 2,500 (1960) in an SMSA)
7. Rural, not in an SMSA; adjacent areas
8. Rural, not in SMSA; outlying areas

APPENDIX A

CONSTRUCTED VARIABLES
(continued)

Density

1. Less than one DU per acre
2. 1.00 - 3.49 DU's per acre
3. 3.50 - 6.49 DU's per acre
4. 6.50 - 11.49 DU's per acre
5. 11.50 - 19.49 DU's per acre
6. 19.50 - 39.49 DU's per acre
7. 39.50 DU's per acre and over

FOOTNOTES

[1]The study which formed the basis of this paper was sponsored by the Bureau of Outdoor Recreation of the U. S. Department of the Interior. Work on the objective density measure was sponsored by a grant to the Institute for Social Research from the National Science Foundation - RANN Division.

[2]The analyses of the relative importance of assessments of neighborhood attributes in predicting overall neighborhood satisfaction is in process.

[3]The methodological study is one of several being funded at the Institute for Social Research through a grant from the National Science Foundation.

[4]See Lansing et. al, p. 107 for a detailed discussion of the procedures for calculating residential density.

[5]The procedure and cost estimates used in obtaining measures of residential density are described in a Survey Research Center staff working paper "A Methodology for Measuring Residential Density in National Samples" by Robert W. Marans and Jean Wineman.

[6]See Appendix A for categories of this constructed variable.

[7]See Appendix A for the classes used in the size of place of residence and urbanicity variable.

[8]When urbanicity and the objective density measure were added to the base set of predictors, the partial R^2 was 3.2 percent.

REFERENCES

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[3] Lansing, John B., Robert W. Marans and Robert B. Zehner, Planned Residential Environments, Ann Arbor: Institute for Social Research, The University of Michigan, 1970.

[4] Mandell, Lewis and Robert W. Marans, "Participation in Outdoor Recreation: A National Perspective," Ann Arbor: Institute for Social Research, The University of Michigan, 1972.