Social Science Methodologies for Studying Individuals' Responses in Human Issues in Horticulture Research

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SUMMARY. Many of the research questions that have been posed regarding the effects of plants on people can only be answered using methodologies from the social sciences. Lack of familiarity with these methods and their underlying concepts has limited the role that horticulturists have taken in this research. Horticulturists, because of their particular sensitivity to the various aspects of plants and the nature of the ways that people interact with plants, must be involved in this type of research to generate the information that is needed by horticultural industries. This paper reviews many of the common methods that have been used in research on human issues in horticulture and presents examples of studies that have been conducted using these techniques. Quantitative and qualitative methods are discussed.

In the past decade, members of ASHS have had many opportunities to learn about, become involved in, or present research findings on human issues in horticulture. Opportunities have included five national or international symposia on human issues in horticulture (cosponsored by the People-Plant Council); numerous workshops, oral sessions, and poster sessions at ASHS Annual Meetings; and two theme issues of *HortTechnology* [2(2):159–189 and 5(2):94–126]. In 1992, a group of researchers and practitioners working with plants and people met to develop a list of research priorities in the field of human issues in horticulture (Lohr and Relf, 1993). Numerous research questions within five general research areas (human health and wellness, human interactions in urban areas, impacts on children, environmental quality, and economic development and business productivity) were presented. To investigate most of these research questions, theories and methodologies from the social sciences must be used.

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In a HortScience Viewpoint, Relf (1990) stated that there were two major questions asked when she encouraged horticulturists to conduct people-plant research: "Why should horticulturists at land grant universities be involved?" and "Given their limited training in the social sciences, how can horticulturists contribute to such research?" Horticulturists need to be involved because they "...possess the knowledge and skills to focus research on horticultural crops that best meet human needs and obtain data that can be of value to the industry and to horticulture educators" (Relf, 1990).

The purpose of this article is to review some common methodological approaches currently used to study the physiological, psychological, and sociological responses of humans to their environment. It will focus on the most frequently used methods. We will group methods by quantitative and qualitative categories, illustrating some of their distinct approaches and empirical assumptions. Examples of published research in human issues in horticulture will be used to illustrate these methods.

Strategies for human research by horticulturists

There are various strategies that horticulturists can follow when conducting people-plant research. Building interdisciplinary research teams that include researchers from the social sciences will add knowledge and expertise in the human dimensions to the plant aspects of the research issues. Becoming familiar with the various concepts, theories, and research methodologies employed in the social sciences can provide a framework when developing research ideas.

Much of what horticulturists know about conducting traditional horticultural research also applies when conducting research on human issues in horticulture. For example, proper sampling is a critical issue to allow study findings to be generalized to an entire population, whether the population is one of plants or people. In people-plant research, researchers must determine in advance which people will be the appropriate subjects and then a sampling procedure may be used to select the subjects. The basic premise is that results may be generalized only to those individuals who in principle had an equal chance of being included in

the survey sample (Vining and Stevens, 1986). For example, if we wanted to study the role of sympathy flowers in the funeral ritual, we might survey all those who recently received sympathy flowers or all those who had recently sent flowers as a sympathy gift. If we chose to study those who had recently sent flowers as a sympathy gift, we could not conclude anything about people who do not use flowers as part of the funeral ritual.

Methods for studying people's responses to plants can generally be grouped into two approaches. The first approach seeks to measure people's responses to plants in their environment objectively. This is done either by recording subjects' preferences and values on numerical scales in a manner comparable to the measurement of physical benefits such as air and water quality (Schroeder, 1987) or by using physiological measures, such as blood pressure readings, to document physical changes in people in response to plants (Ulrich and Parsons, 1992). This approach is quantitative. The second approach is qualitative and seeks to identify the meaning or significance of plants in people's subjective experiences of their environments. This approach recognizes the importance of emotion, imagination, and intuition in people's experience of the natural world. It does not seek to quantify value, but to describe how people interpret their surroundings relative to their own experiences (Schroeder, 1987).

It has been common to distinguish between quantitative and qualitative methods, and this has been a source of frequent debate (Low, 1987). The discussion implies that one is more rigorous or more effective than the other is (similar to the debate regarding basic versus applied research). True dichotomies are uncommon, and it would be an oversimplification to think that methods of gaining knowledge can be classified into two distinct categories. Rather, empirical research involves a continuum of methods that cannot be easily grouped. For example, in conducting a survey, there can be both quantitative ("how many times did you purchase a cut-flower arrangement in January?") and qualitative ("how did you feel when receiving a foliage plant as a gift?") questions used. Qualitative methods, such as observations, can also be used for collecting

quantitative data. For example, the number of items within a workstation, such as photographs of family members, posters, and plants, not only describes and quantifies a particular attribute of the workstation, but also characterizes the behavior of its occupant.

Quantitative methods

The quantitative approach treats psychological and sociological benefits in a way that parallels the study of physical benefits of plants in our environment (Schroeder, 1987). It assumes that these benefits can be measured reliably and objectively using systematic procedures developed in the social sciences. While reliability and validity are both important in all research, quantitative methods often emphasize reliability, the degree to which a particular measurement can be reproduced. For example, a reliable skin temperature sensor will read 98.6 °F (37 °C) today or tomorrow if that is the actual temperature of the skin of the person being measured.

Marans and Ahrentzen (1987) define quantitative methods on a stratum which "(a) assumes that reality is something concrete and can be experienced, defined, and discussed; (b) employs an instrument external to the researcher which is used to collect information about that reality or one's perception of it; (c) employs measurement, that is, the assignment of numbers to observable responses and conditions such that the numbers are amenable to analysis according to certain mathematical rules; and (d) assesses relationships among two or more variables."

Quantitative research designs can be classified as experimental, quasiexperimental, and survey (Marans and Ahrentzen, 1987). The strength of quantitative research lies in its effectiveness for testing deductive theories and generalizing the findings.

EXPERIMENTAL DESIGNS. Experimental designs are the foundation of the plant sciences. Whether studying plants or people, the nature of the design is the same: a presumed "treatment" or independent variable is introduced to one group of participants but not to others, and the conditions and characteristics of those receiving and not receiving the treatments are assumed equivalent. Equivalency is established in human issues in horti-

culture research through the random assignment of participants to treatments, just as treatments would be randomly assigned to plants in a field.

A common experimental design used to assess people's responses to plants is to expose people to different experimental treatments (for example, a setting with plants and the same setting without plants) while monitoring a quantitative response, such as skin temperature. One such study was conducted in a computer lab with or without plants present (Lohr et al., 1996). Subjects were randomly assigned to the treatment condition. Participants' blood pressure, measured before, during, and after completing a computer-based productivity task, was lower when plants were present. Other studies have used three treatments to control for particular aspects of what plants may be contributing. Coleman and Mattson (1995) compared people's responses in the presence of a plant on a stool, a photograph of the plant on a stool, or the stool alone. While the results of this study were not significant, perhaps due to a small number of subjects, this study provides a good example of appropriate treatment selection. Lohr and Pearson-Mims (2000) measured people's responses to discomfort in a control room, a room with colorful objects, or a room with plants, thus extending the conclusions that can be made about plants beyond their role of adding color. Adachi et al. (2000) used floral displays, foliage displays, or no displays in a study of effects on human emotions.

Many studies using experimental design to examine human responses to plants and nature use physiological measures to determine the response. Physiological responses can be used to infer psychological benefits, because these can be reflected in responses or levels of activity in numerous bodily systems, such as the cardiovascular. The physiological findings are an important complement to the more subjective psychological data, because the physiological measurements are of the activation state of the individual (Berlyne, 1971; Duffy, 1972; Ulrich, 1981). Physiological measurements are widely recognized to have scientific credibility as indicators of stress and restoration (Ulrich and Parsons, 1992). The physiological methods can identify influences on well-being that may

be outside the conscious awareness of individuals and hence may not be identified by verbal measures such as ratings or questionnaires. Also, the physiological procedures offer the advantage of allowing continuous measurements of an individual's condition during an experiment. Thus, the use of both psychological and physiological measures makes possible a deeper level of understanding and wider range of inferences (Ulrich, 1981). Ulrich (1981) pointed out that compared to studies based exclusively on intuitive or subjective procedures, investigations utilizing physiological or medical measures have been more successful in motivating governmental action and public concern.

Physiological measures that have been used to study people-plant interactions include recording brain electrical activity (Ulrich, 1981); pulse transit time (a correlate of blood pressure), muscle tension, and skin conductance (Ulrich et al., 1991; Wise and Rosenberg, 1988); and blood pressure (Doxon et al., 1987). Obviously, research in psychophysiology may require sophisticated, and often, expensive instrumentation. Because of the expense and limited use of this kind of equipment within a horticulture department, collaborating with a behavioral scientist that conducts psychophysiological research should be considered. Results from studies with physiological measures show that vegetation and natural settings are able to promote relaxation and recovery from stress much more effectively than man-made environments lacking in plants (Ulrich, 1981; Ulrich et al., 1991).

QUASIEXPERIMENTAL DESIGNS.

Quasiexperimental designs are of two types: nonequivalent control group designs and interrupted time-series designs (Marans and Ahrentzen, 1987). A distinguishing feature of quasiexperimental studies is that, unlike experimental design, treatment groups are not randomly assigned. These designs are often utilized for horticultural therapy research, extension program evaluation, and visitor studies at public gardens (Hlubik and Weidman, 1995). Fjeld (2000) used these methods to document a reduction in health-related discomfort symptoms, such as headaches, among people in buildings when plants were present.

The nonequivalent control group design allows for comparisons between

the effects of a treatment and its absence to be made using pretest and posttest comparisons between nonequivalent groups. These designs are similar to those for experimental designs, except that the members in the control and treatment groups are constrained by forces beyond the experimenter's control, and thus are not randomly assigned. Here is a hypothetical example of a pretest-posttest nonequivalent control group design: a researcher measures the change in people's feelings after adding plants to an office and compares that to the change in people's feelings over the same time period in another office where plants were not added. In this example, the researcher could not randomly assign workers to the different offices.

One study that illustrates the difference between the nonequivalent control group design (Bummer, 1989) and true experimental design (Lohr and Bummer, 1992) assessed change in people's attitudes towards water-conserving landscapes with and without viewing a video. By randomly assigning subjects to treatment and control groups, the researchers showed that people in both groups improved their attitudes, perhaps because participating in the pretest got people thinking about the subject, but those who watched the video improved their attitudes more than those who did not watch it (Lohr and Bummer, 1992). Pretest and posttest scores were also obtained for nonrandom groups: students taking horticulture or landscape architecture courses (Bummer, 1989). Some of the classes viewed the video while others did not. This portion of the study revealed similar trends to the experimental design study, but also illustrated the interpretation difficulties that can be introduced when the groups cannot be randomly assigned and the researcher cannot clearly separate treatment differences from group differences.

Interrupted time-series designs are used when comparisons are made among the same subjects before and after a treatment (Marans and Ahrentzen, 1987). The problems inherent in this design are the same as those encountered when repeated measures are made on the same plants in traditional horticultural research: measurements on the same person (or plant) will be correlated, so appropri-

ate statistical procedures must be used. In other cases, the treatment may be introduced and withdrawn at various intervals, with measures being taken before and after the treatment times, so that the researcher may better distinguish between treatment effects and external, unrelated effects, such as maturation.

SURVEY DESIGNS. Survey designs use questionnaires, structured interviews, and observation. They are deceptively easy to compose and distribute, however, correct use demands consideration of many issues, only a few of which are described here. Many references are available to help with the design of surveys and will not be covered in this paper. Dillman's (1978) book, in particular, has been the standard in this field for many years and is highly recommended; a revision of this classic reference, incorporating Internet surveys, has just been published (Dillman, 2000).

Most quantitative research in the environment-behavior field, including people-plant research, incorporates a survey design. Surveys and questionnaires have been a very popular means of assessing the opinions, attitudes, and perceptions of the general public. Preference research and written questionnaires, two survey design methods commonly used in people-plant research, will be presented as examples of this type of research.

In typical landscape preference assessment studies, groups or individuals are shown a variety of environments, usually depicted in photographs or slides, and asked to rate each scene in terms of how much they like it. The rating responses are then analyzed statistically and compared to the physical characteristics of the environments. Several studies have investigated the validity of using images to represent environments and have found that photographs or slides can be reliably used for actual environments (Pitt and Zube, 1979; Daniel and Boster, 1976). There are many different methods to measure and analyze the responses of study participants to each environment shown. Categorical rating scales (Daniel and Boster, 1976), category identification (Kaplan and Kaplan, 1989), rank order (Buhyoff et al., 1978), paired comparison (Buhyoff and Wellman, 1979), and Q-sort procedures (Pitt and Zube, 1979) are some examples. Each of these meth-

ods has advantages and disadvantages (Daniel and Boster, 1976). Schroeder (1984) provides a careful analysis of the differences among such approaches and concludes that simpler methods have distinct advantages and are "appropriate for a wide range of applications."

Preference studies generally produce reliable, consistent, and believable results. For example, many studies have shown that environments with vegetation and natural features are more attractive than urban environments lacking natural elements (Berge and Lohr, 1994; Herzog et al., 1982; Ulrich, 1986), that trees are preferred to open grasslands (Kaplan et al., 1989), that big trees are usually more attractive than small trees (Schroeder and Cannon, 1983), and that perceived safety is strongly related to the distance that one can see into the surrounding area (Schroeder and Anderson, 1984).

When developing written questionnaires, researchers must carefully word and pretest all questions to ensure they measure the intended information (Vining and Stevens, 1986). Survey questions may be phrased in many different ways, any of which may introduce bias. The response given by a survey participant depends on the way in which the question is phrased as well as on the type of question presented.

There are two basic formats for survey questions: open-ended and closed-ended. Open-ended questions are those that encourage participants to choose their own words in response to a question, such as "what do you feel when you look at large trees?" Open-ended questions elicit a wide range of responses from the participants. Such responses may be qualitative and provide rich information at the cost of coding, analyzing, and interpreting those data. Because responses are variable, they may be difficult to interpret. Closed-ended questions provide participants a list of predetermined answers from which to select, such as "agree," "disagree," and "no opinion." These provide more precise and easily analyzable information than open-ended responses, but at the expense of constraining the respondent's answer (Vining and Stevens, 1986). Open-ended questions are optimal in pilot studies where issues must be identified. After this point, closed-ended questions, generated

from results of the open-ended data, are typically used for efficient data analysis.

Using closed-ended questions in their survey, Dunnett and Qasim (2000) were able to obtain information from 376 people. They found, for example, that people of different ages derive different benefits from gardening. An open-ended question was used to discover what people felt were the contributions that their gardens made to the wider environment. Using only closed-ended questions, Skelly and Zajicek (1998) found that children who engaged in more outdoor activities held more positive environmental values than did children who engaged in fewer outdoor activities.

Because of their ease of development and their generally low cost, mail surveys are a commonly used tool. One study mailed surveys to Master Gardener coordinators through the US and Canada (Flager, 1992). Using this simple method, the author was able to determine that about half of the states with Master Gardener programs also have Master Gardener-assisted horticultural therapy programs. Surveys, in conjunction with observations and interviews, were used in a study on the role of outdoor settings in promoting well-being among the people in retirement communities (Browne, 1992). This study documented people's strong desires for grounds that are pleasantly landscaped, aesthetic, and accessible. People wanted places to walk and observe nature, as well as places to personalize the grounds.

Another critical issue in survey administration is the proportion of responses received from sampled individuals (Dillman, 1978). Telephone surveys generally result in high response rates, but discriminate against people who do not own telephones. Surveys distributed through the mail or on-site may not be returned, for various reasons unknown to the surveyor. For example, a questionnaire might be lost and therefore not returned by an interested individual, or not returned because an individual is disinterested. Those surveys that are returned may then constitute a biased sample and the surveyor will have no idea of the reason for or direction of the bias.

Qualitative methods

"Qualitative methods focus on validity and draw their strength from

the close fit between the actual situation and the researcher's description, understanding, and interpretation of that situation" (Low, 1987). An operational definition of qualitative methods includes: 1) the researcher is the major instrument of data collection although he or she is aided by interview schedules, observational diagrams, or predetermined questions; 2) data collection and recording encompass both the subject and the context (environment) usually recorded in terms of their interrelation; 3) the research setting is most often the natural environment of the activity, person, or situation; and 4) data analysis is an interpretive process generating its own theoretical and data categories (Low, 1987). The most common methods of gathering qualitative data are interviews, focus groups, observations and questionnaires. Other qualitative methods not yet commonly used in people-plant interaction research, but that do have application include: phenomenological methodologies, comparative historical methodologies, ethnographic methodologies, and discourse analysis. These methodologies are reviewed in Low (1987).

PERSONAL INTERVIEWS. The qualitative nature of personal interviews make them ideal to explore people's thoughts in depth, as they provide a unique opportunity to probe for more information when an answer is ambiguous or when it appears to provide unique insights or observations. To maintain objectivity in the collection of data, however, it is critical that the survey administrators be well trained to avoid the biases that they can elicit by injecting personal interpretations to questions or providing positive feedback to specific lines of answering.

One common way to analyze qualitative data collected in interviews is to review transcripts and code responses by the use of common terms or concepts, using different raters to check for agreement. This method was used to interpret interviews with people who had been hit by Hurricane Hugo (Hull, 1992). The interviews revealed that aspects of the urban forest, such as trees and parks, were the most valued physical feature that had been damaged by the hurricane. People also felt that the urban forest was the feature they had most taken for granted before the damage.

Interviews with 133 gardeners

provided the input for a survey to determine how individual gardeners were learning about new gardening and what information sources were associated with the adoption of new gardening technologies (Patel and Okai, 1992). This study demonstrated, for example, the importance of repetition of information for adoption of new gardening practices.

Interviews can also be used to collect quantitative data, and the personal contact is an effective means of increasing response rates. Nationwide, in-home interviews with more than 2000 people were conducted as part of the National Gardening Association's National Gardening Survey (Relf et al., 1992). Seven closed-ended questions on the value of plants to people were asked in 1989. This report showed that the results of individual studies with specific populations on the perceived positive benefits of plants do apply to a broad cross-section of Americans.

FOCUS GROUPS. Krueger (1988) defines a focus group as a special type of group in terms of purpose, size, composition, and procedures. Focus groups are useful either as a self-contained means of collecting data or as a supplement to both quantitative and other qualitative methods. The strength of focus groups is the explicit use of the group interaction to produce data and insights that would be less accessible without the interaction found in a group. The major advantage of focus groups is that they offer the chance to observe participants engaging in interaction that is concentrated on attitudes and experiences that are of interest to the researcher. Experienced interviewers should be employed to run focus groups to ensure unbiased results.

A focus group is typically composed of seven to ten participants who are unfamiliar with each other. The interview is conducted by a skilled interviewer in a permissive, nonthreatening environment. It usually does not last more than 2 h. Five to seven questions are developed to be used as a guide by the interviewer for the discussion. The questions are designed to obtain perceptions on the defined area of interest. A successful focus group will have interaction between the participants rather than just with the interviewer. Attitudes and perceptions are developed in part by interaction

with other people. Focus groups are not intended to develop consensus, to arrive at an agreeable plan, or to make decisions about which course of action to take.

The focus groups are usually audio-taped. The transcriptions of the interviews are the primary data this type of research creates, and these can be analyzed by different approaches (Morgan, 1988). A useful strategy with focus group research is to conduct and analyze one or two focus groups, then use the results to develop hypotheses and coding schemes that can be applied when the remainder of the groups are conducted and analyzed.

Focus groups with people who had recently lost a loved one provided the data for a study on the role of flowers in bereavement (Shoemaker et al., 1992). The content of the focus groups was partly developed from questionnaires completed by funeral directors. This study showed that, in addition to comfort, flowers are important for their role in providing a topic of conversation beyond talk of the deceased.

OBSERVATION. When studying human behavior there is a concern with both preference and survey research: the link between preference (attitude-opinion) and actual behavior may not be explicitly evaluated. Observing or measuring behavior in the actual setting, although not feasible in many cases, is a useful means for obtaining this information. Recording people's behavior provides a direct indicator of human activities in a particular environment. Behavioral measures are a broad class of methods for directly observing and measuring human activities which have many advantages, the most obvious of which is their face validity (Vining and Stevens, 1986). Observational methodologies are reviewed extensively in Ås (1975), Sommer and Sommer (1980), Webb et al. (1966), and Zeisel (1981).

Matsuo (1992) employed observation in his study on cut-flower use for tombs in Japan. He observed what species of flowers people placed on tombs in different cities and in different seasons in Japan. He found that use was heavily associated with major events, such as the new year and spring equinox, in Fukuoka, while use was more evenly distributed in Kagoshima. Direct observations of behavior were used in another study to show how

children and older people interacted during horticultural therapy activities (Predny and Relf, 2000).

Conclusions

Regardless of the research design that is used; whether it is "basic science," "applied science," or "social science;" and whether it is quantitative data or qualitative data; the fundamental goals of research are the same: to develop theories and test hypotheses to understand our world. Currently, preference research, psychophysiology research, interviews, observation, and survey-questionnaire administration are the most common approaches used to study the people-plant interaction. This paper has provided a brief review of these methodologies. Plant scientists can successfully develop, participate in, and conduct human issues in horticulture research by building an interdisciplinary research team and becoming familiar with the various research methodologies used in people-plant interaction research.

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