Research Methodologies for Studying Human Responses to Plants

Candice A. SHOEMAKER
Associate Professor, Department of Horticulture, Forestry, and Recreation Resources Kansas State University

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Formal research to document and isolate many of the impacts of plants on people began to appear in the 1970s with a few research studies from social and medical scientists (Kaplan 1973; Talbott et al. 1976). However, the benefits that an individual can derive from plants have been discussed for thousands of years (Stein 1990). Psychiatrists and other mental health workers have been using horticulture as a therapeutic tool for over one hundred years (McCurry 1963; O'Connor 1958), with benefits cited including intellectual and emotional growth, as well as improved social and motor skills (Hefley 1973). Additionally, beliefs in the curative effects of gardening for the mentally ill are at least several hundred years old (Watson and Burlingame 1960). Yet, much more remains to be documented.

In many ways, it seems incredible that we need to find evidence of how people depend upon and value plants. The reality is obvious all around us-we use plants to surround our homes, to celebrate holidays and special occasions, as gestures of love and more. Yet, at the same time, our modern lifestyle has distanced us from nature and plant life, often by our own choice.

The remainder of this paper will review some common methodological approaches currently used to study the physiological, psychological, and sociological responses of humans to horticulture and their environment.

What is Research?

To begin with, we first need to agree on what exactly research is. The word research can mean many different things. We "research" various cars before buying a new one. We "research" vacation spots when planning our vacation. However, when I talk about research I mean the discovery of new knowledge in a systematic and unbiased way. The key points to this definition are "new knowledge", "systematic", and "unbiased". Being systematic and objective will lead to the development of generalizations, principles, or theories, resulting in prediction and possibly ultimate control of events.

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Characteristics of Research

- ➢Research begins with a question: We all have asked "Why", or "what's the cause of that?" or "what does it all mean?" The question or questions are the departure point for research.
- ➢Research requires a plan, direction, and design: This is a critical component of research. The more planning we do the more certain we will be of our conclusions. Research is an orderly procedure, planned and logical in design.
- ➢Research demands a clear statement of the problem: A clear statement of the problem means that you understand the problem and have looked at it objectively. We must see clearly what it is we are attempting to research.
- ➢Research deals with the main problem through subproblems: Most researchable problems have within them various other problem areas of lesser breadth and importance. By defining the subproblems the project becomes more manageable.
- ➢Research seeks direction through appropriate hypotheses or educated guesses to assist you in discovering the solution and in giving you direction in looking for the facts.
- ➢Research deals with facts and their meaning.
- ➢Research is circular: We begin with a question and through the process of research we solve the problem and return to the question with the answer.

Defining the Problem

Clearly defining the problem from the onset will increase the likelihood of obtaining useful, relevant information. A suggestion for getting started is too look at another's research. Researchers are often inspired by another's research. Expanding on previous research or modifying it will provide new insights. This has certainly been the case in people plant research. Recent research, has indeed, built on, and expanded the early research on the psychological and physiological responses of people to plants.

For example, in Roger Ulrich's classic research paper (1984), he reported on the health benefits to hospital patients from having a room with a view of trees rather than a view of a brick wall. He showed that these patients spent less time in the hospital (7.96 vs. 8.70 d), used fewer doses of strong pain relievers, and received fewer negative comments from hospital staff on their charts. Several studies have followed Ulrich's, investigating the same thing — a view from a room — but with different populations. West (1985) found that prison-cell window views of nature, compared to views of prison walls, buildings, or other prisoners, were associated with lower frequencies of health-related stress symptoms such as headaches and digestive upsets. Tennessen and Cimprich (1995) tested college students in their own dormitory rooms — some with window views dominated by nature, others with views dominated by hardscape — and learned that students with nature views were better able to focus their attention to the desired tasks given them. A study by Kuo and Sullivan (1996) asked apartment complex residents about domestic violence — some lived in apartments surrounded by trees, others lived in apartments without green surroundings and were not able to select what apartment they would live in. They learned that incidence of domestic violence were significantly lower for residents in apartments surrounded by greenery — 22% vs. 13% had engaged in violence and 14% vs. 3% had hit their children, respectively.

A more difficult application of this principle would be in studying the therapeutic effects of horticulture therapy. For example, Song and Sim (1999) studied the effects of a horticultural therapy program on schizophrenics with negative symptoms. Two likely modifications would be to change the population studied or change the therapeutic application used while all other variables remained the same — this last part is what makes this difficult. However, this does not mean that previous reported research on therapeutic effects of horticulture therapy cannot be used to guide your research. Also, consider modifying occupational therapy and physical therapy research — in this case, the modification could be the therapeutic application.

When defining the problem we must state operational definitions to allow quantification of the results. These definitions help to establish the frame of reference with which the researcher approaches the problem. For example, when we talk about "quality of life" or "psychological well-being" what are we talking about? What is "quality of life"? What is "psychological well-being"? When writing operational definitions consider things such as physical health, behavioral repertoire, reaction to stress, and competence, to define these terms.

We must also state assumptions implicit in the study. For example, say we wanted to study the relationship between landscape architecture and therapeutic garden landscapes. An implicit assumption to this problem is that there is a relationship between the two types of landscape. It may seem obvious but it is important to state. We must also state limitations which are those conditions beyond the control of the researcher that may place restrictions on the conclusions of the study and their application to other situations. For example, a data-gathering instrument that has not been validated or the inability to randomly select and assign subjects to experimental and control groups are limitations. In addition, we must state delimitations, which are the boundaries beyond which the study is not concerned. Simply put, delimitations are pre-meditated limitations. For example, the researcher deliberately narrows down, excludes, and is selective with all subjects.

Also, consider the following questions:

- Is this the type of problem that can be effectively solved through the process of research?
- Is the problem significant? Does it provide fresh insights for your profession?
- Is the research on the problem feasible? Do you have sufficient time to carry it out? Do you have access to subjects? Do you have access to the proper equipment or research tools?

Stating the Problem

Once you have defined the problem you can then state the problem in either question form or as a declarative statement. State the problem fully and precisely. It must be limited enough in scope to make a definite conclusion possible. Statements such as "psychological implications of horticulture in urban environments: or "health benefits of gardening for older adults" are not statements of problems, they are broad areas of concern from which problems may be selected. A problem suggests a specific answer or conclusion.

The Hypothesis

The research hypothesis is a reasonable guess, an educated conjecture which may give direction to thinking with respect to the problem, and thus, aid in solving it. It limits the focus of the investigation to a definite target and determines what observations are to be made. A good hypothesis is reasonable, consistent with known facts or theories, and is stated in such a way that it can be tested and found to be probably true or probably false.

Sampling

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.

Types of Research

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).

Although it is common to distinguish between quantitative and qualitative methods I prefer to not consider them as dichotomous, but rather complimentary. 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 98.6F (37C) today or tomorrow if that is the actual temperature of the skin of the person being measured. 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

The nature of experimental design is that 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. In other words, experimental research deals with the phenomenon of cause and effect. Equivalency is established in human issues in horticulture research through the random assignment of participants to treatments.

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. An example of this method was a study conducted by Lohr, Pearson-Mims, and Goodwin (1996) in a computer lab with or without plants present. 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.

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, inves-

tigations 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, therefore collaboration with behavioral scientists that conducts psycho-physiological research should be considered. Results from studies with physiological measures show that vegetation and natural settings are able to promote relaxation and recover 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 comparison 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.

Interrupted time-series designs are used when comparisons are made among the same subjects before and after a treatment (Marans and Ahrentzen 1987). The time-series design consists of taking a series of evaluations and then introducing a variable or new dynamic into the system after which another series of evaluations is made. If a substantial change results in the second series of evaluations, we may assume with reasonable experimental logic that the cause of the difference was because of the factor introduced into the system.

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 appropriate 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 will be presented. Many references are available to help with the design of surveys. Dillman's book *Mail and telephone surveys:* The total design method (1978) 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.

Preference 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.

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).

Written Questionnaires

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 chose 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, can provide rich information, but can 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.

Dunnett and Qasim (2000) in their study of the perceived benefits to human well-being of urban gardens used both closed-ended and open-ended questions. From the closed-ended questions they found, for example, that people of different ages derive different benefits from gardening. An open-ended question to discover what people felt were the contributions that their gardens made to the wider environment determined that the two most common values were creation of a more beautiful environment and promotion of relaxation.

Qualitative Methods

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.

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 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 (Butterfield and Relf 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.

I used focus groups with people who had recently lost a loved one to provide 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. Results of the focus groups were useful in preparing the written questionnaire that was used in a nation wide survey of recently bereaved.

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 meth-

ods for directly observing and measuring human activities that have many advantages, the most obvious of which is their face validity (Vining and Stevens 1986).

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.

Collaboration

Another useful guiding principle is collaboration. The interdisciplinary research team approach is an excellent model for studying people plant relationships since it impacts so many different disciplines – horticulture, design, sociology, education, geography, medicine and psychology to name a few. The interdisciplinary research team approach offers many benefits:

- It offers opportunities for cross-fertilization of ideas as individuals in seemingly unrelated areas recognize shared interests.
- It highlights and builds on the expertise of each individual on the team.
- It provides differing perspectives when approaching a research problem based on the understanding of the discipline of each individual on the team.
- It serves as a focus or support for other activities such as development of workshops.

Collaboration is also useful for those of us wanting to do research but are not in the academic world. We can look within our own institutions for opportunities for collaborations or consider other institutions. Quite often, horticultural therapists must defend the value of what they are doing to administrators and funders yet may not know how to determine the value. Understanding how to do research is critical for the horticultural therapist and the profession of horticultural therapy.

Communication

The final general guiding principal I would like to mention is communication. What is the point in doing research if you are not going to communicate your findings? Communicating the results of research must be planned as an integral part of a comprehensive research initiative. Communicating negative or incomplete results is as important as positive results, as they can serve as guides to other researchers. Several levels of communication need to be considered from publishing in refereed journals to communicating with the public. Diane Relf (1992), in the proceedings of the first people plant symposium discusses the need for communicating the findings as well as the pros and cons of the various levels of communication that are needed.

Conclusion

Our understanding of the value of plants to people has progressed significantly over the past 10 years. Yet there are still many questions to be answered about the impact of plants on people that there is room for all types of research strategies to be used.

I hope I have demonstrated the wide array of research methods available for studying human responses to horticulture and their environment. I also hope I have inspired you to help document what we all know intuitively and hear anecdotally. Examine what you believe about how plants are affecting you. Consider what others are saying about how plants are affecting them. Generate researchable questions and then communicate your findings.

To conclude, horticulture benefits us economically, psychologically, mentally, emotionally, socially, and educationally. We stand to gain in many areas if we prove this in substantial terms through research as it will direct the growth and development of the profession.

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