The Qualitative Report

Volume 8 | Number 2 Article 9

6-1-2003

Dare I Embark On A Field Study? Toward An Understanding Of Field Studies

Yan Xiao
University of Maryland, yxiao@umaryland.edu

Paul Milgram
University of Toronto, milgram@etclab.mie.utoronto.ca

Dare I Embark On A Field Study? Toward An Understanding Of Field Studies

Abstract

Field studies have frequently been advocated as a means for understanding cognitive activities in naturalistic settings. However, there are several fundamental obstacles that one has to overcome to conduct a field study. This paper discusses two of these obstacles in the context of studying problem solving in complex environments: defining goals of a field study and justifying methods used in data analysis. Based on our experience from a recently finished field study, we outline a framework for understanding the nature of field studies and suggest a specific approach to data analysis. We argue that the goal of field studies should not be limited to hypothesis testing, and that the process of data analysis in field studies can be viewed as an inductive abstraction process. Our field study is used to illustrate the abstraction approach to data analysis and how the obstacles in field studies were dealt with. Through these discussions, we encourage researchers to engage in more field studies.

Keywords

Field Study Methodology, Cognitive Engineering, Anesthesiology, and Data Abstraction

Acknowledgements

The research was supported by an IBM Canada Doctoral Fellowship and NSERC Research G r ant #OGP0004101. The writing was partially supported by ONR Grant #N00014-91-J-1540. The authors are grateful f o r the inputs and suggestions of John Doyle and Kim Vicente.

The Qualitative Report Volume 8 Number 2 June 2003 306-313
http://www.nova.edu/ssss/QR/QR8-2/xiao.pdf

Dare I Embark On A Field Study? Toward An Understanding Of Field Studies

Yan Xiao
University of Maryland, College Park, Maryland USA

Paul Milgram
University of Toronto, Toronto, Ontario Canada

Field studies have frequently been advocated as a means for understanding cognitive activities in naturalistic settings. However, there are several fundamental obstacles that one has to overcome to conduct a field study. This paper discusses two of these obstacles in the context of studying problem solving in complex environments: defining goals of a field study and justifying methods used in data analysis. Based on our experience from a recently finished field study, we outline a framework for understanding the nature of field studies and suggest a specific approach to data analysis. We argue that the goal of field studies should not be limited to hypothesis testing, and that the process of data analysis in field studies can be viewed as an inductive abstraction process. Our field study is used to illustrate the abstraction approach to data analysis and how the obstacles in field studies were dealt with. Through these discussions, we encourage researchers to engage in more field studies. Key words: Field Study Methodology, Cognitive Engineering, Anesthesiology, and Data Abstraction

Introduction

Studies of problem solving in naturalistic settings have been called for by many researchers (e.g., Klein, Orasanu, Calderwood, & Zsambok, 1993; Moray, 1992; Sheridan & Hennessy, 1984). It is believed that such studies could examine how people solve problems and make decisions in real work environments. Indeed, studies over the past several decades have accumulated evidence (e.g., Amalberti & Deblon, 1992; Rasmussen, 1976; Xiao, Milgram, & Doyle, 1993) that should direct further research attention to studies in work environments, to examine how various factors interplay in operational settings.

As important as are studies of human cognition in naturalistic settings, a number of obstacles confront researchers. Some of the obvious ones include the length of the time it typically takes to get oneself acquainted with a domain (the domain "barrier"), and the lack of control over the types of behavior to be observed and over the data to be collected ("messiness" in data). More fundamental obstacles, however, include those that are methodologically flavored, such as the difficulties in defining the goals or "final products" of a naturalistic study and in justifying the data analysis methods used relative to the types of data expected in such a study. These methodological difficulties create

probably the most formidable obstacles to those who are about to embark on a naturalistic study of human problem solving.

In this paper, we address these two questions in the context of conducting *field studies* in complex work domains. Our central thesis is that the process of a field study can be viewed as abstraction from field data to general statements or hypotheses about observed behavioral patterns. A recently finished field study on problem solving (Xiao, 1994, see also an overview in Xiao, Milgram, & Doyle, 1993, in press) is used as a general reference. (The field study was conducted in the domain of anesthesiology.) In the present paper we outline some of the rationales for establishing research goals for field studies and the nature of data analysis. Our intention here is to encourage more people to initiate field studies and thereby to expedite the maturation of the methodology of field studies.

The characteristics of field data and the goals of field studies

Complex systems often involve the assumption that the actors are well experienced and much of their roles in the system are cognitively defined (e.g., decision making and problem solving; see Sheridan & Hennessy, 1984). Much of our interest is in their *covert* behavior (i.e., activities not directly observable). Furthermore, the actors are likely to be governed principally by the high level goals of the system and thus they have large freedom of choice of strategies for achieving those goals (Moray, Lootsteen, & Pajek, 1986). These factors contribute to the difficulties in obtaining behavioral data and in analyzing them, even in laboratory settings. Under field conditions, one's abilities to sample behavior and obtain direct and indirect behavioral data (such as verbal protocols) are further constrained. Inevitably, the data collection process under field conditions must be opportunistic, rather than systematic.

In addition, the subjects' behaviors will likely be composed of several threads of activities. When observed over time, the number and the contents of these threads may change. Thus the researcher has to be able to "parse" the behavioral stream and find proper levels of analysis (see also the discussion on activity analysis in Rasmussen, Pejtersen, & Goodstein, 1994).

In our field study of anesthesiologists, we found that the nature of field data made it extremely difficult, if not impossible, to establish causal relationships from field data. Studying correlational relationships became unrealistic also due to the large variation of activities from one case to another. In fact, at the beginning of the field study, it took a considerable amount of effort simply to decide which aspects of our subjects' behavior to investigate, let alone to formulate hypotheses for testing. What we ultimately chose as the research goals was (cf. Woods, 1993) to "discover," or somehow formally characterize, the strategies and patterns of activities observed in the field (as opposed to hypothesis testing or theory validation).

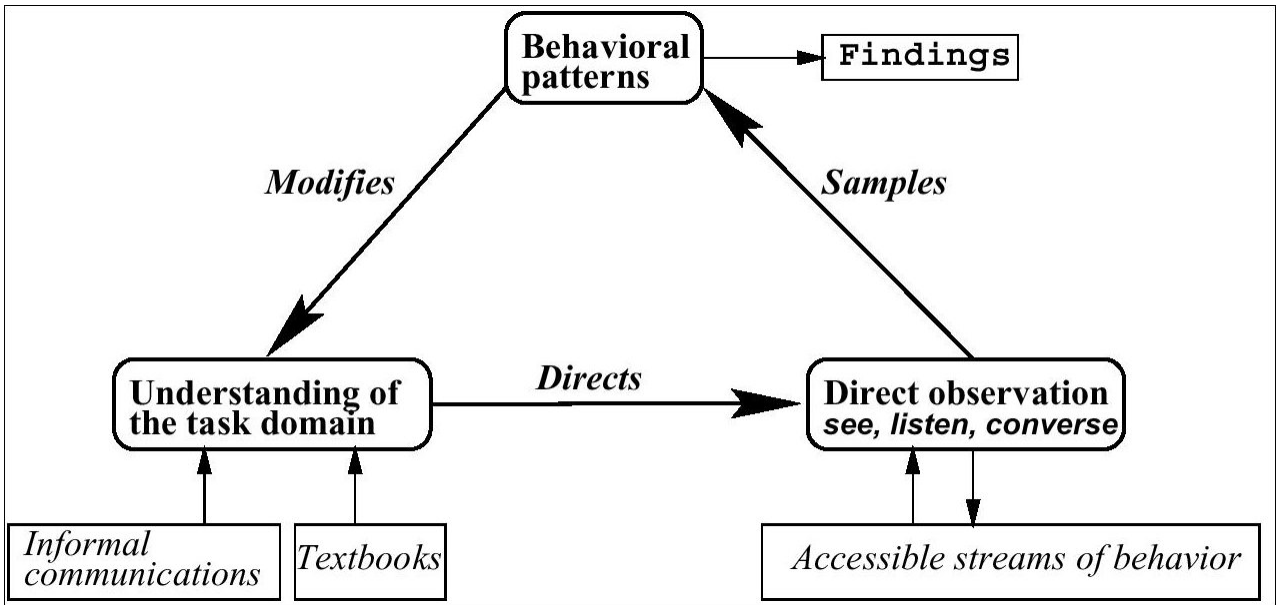
The success of a field study depends on how it fulfills its ultimate objectives, even though its immediate goals may not be hypothesis testing and theory and principle validation. In many field studies, the goal should lie beyond making and supporting statements, which are pertinent only to the specific domain of the field study. The findings from a field study should reveal, in non-domain-language terms, the characteristics of the human cognitive system, rather than the specific responses made to

particular situations in the studied domains. This requirement translates into the demands on the field investigator in two areas. One the one hand, the researcher has to be domain-literate, so that he or she can understand the significance of events and activities in their domain context (cf. Hutchins, 1980). On the other hand, the researcher has to be sensitive to the cognitive processes underlying the observed activities, so that he or she will be able to put forward hypotheses that will have bearings on such factors as knowledge requirements, workload, generic strategies, cognitive bottlenecks and the need for cognitive support.

It is certainly an extremely daunting task for an investigator to proceed at the beginning of a field study, while potentially knowing little about the domain to be studied and without, at the same time, clearly defined, specific research questions. We found that it was useful to think of the process of field study as an understanding process, both about the domain and about the cognitive activities under study. This process can be viewed as a cyclic one, as experienced in our field study (Xiao, 1994) and depicted in Figure 1 (which is reminiscent of Neisser's 1976 perceptual cycle). The field study process, like Neisser's perceptual cycle, can be viewed as an iterative process of (i) forming hypotheses of behavioral patterns, (ii) making predictions, and (iii) verifying those predictions, all in an overlapping manner. The findings are essentially the results of the final iteration.

Although field studies may carry the intonation of direct observation, one has to rely on a variety of data sources to establish hypotheses and guide one's observations, as well as one's interpretation of observed data. In our study, informal conversations with practitioners and chatting among practitioners in coffee lounges were found to be extremely helpful in appreciating the observed activities, from an "insider's" point of view (Figure 1).

Figure 1: Conceptual cycle of field studies, after Neisser's (1976, p. 21) perceptual cycle.



Abstraction and interpretation as the central effort of data analysis

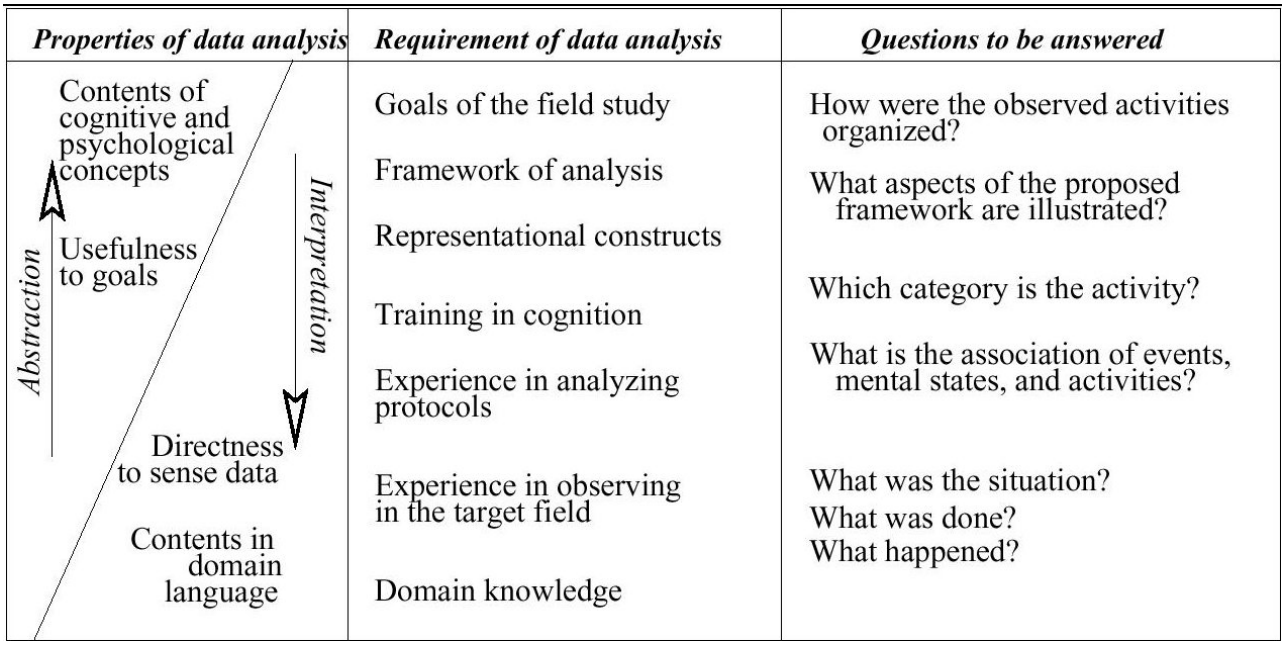
Field data, as discussed above, will likely be unsystematic and opportunistic. Many factors shape the data that one collects. At a superficial level, the data collected depend on the process of verbalization by the subject (the person under observation), the technique of interviewing, the recording tools used, etc. At a deeper level, the type of the case the subject happens to be working on determines directly the kinds of problems the subject will have to solve.

One general approach, which was adopted in our field study, was viewing the process of data analysis as a series of inductive abstractions. This approach was first advocated by Hollnagel, Pedersen, and Rasmussen (1981). They characterized data from field and other types of studies as *performance fragments*, "in the sense that they do not provide a coherent description of the performance, but rather the necessary building blocks or fragments for such a description" (p. 10). The basic idea of the approach is to *abstract* the raw data, to remove context specifics and to *identify* strategies, performance criteria, etc. used by practitioners.

In our field study, for example, the coding of protocol data was treated partly as an actual step in the abstraction process. The ultimate objectives of the coding were no longer a computational model, but a representation of practitioners' strategies that could be useful for formulating training programs and for guiding designs. In carrying out the protocol analysis in our field study, special attention was paid to those aspects in behavior that were *case-independent*, and to presenting findings in ways that enabled the results to be widely applicable. This approach to protocol analysis is in contrast with traditional approaches, which take protocol analysis as a means of acquiring specifications and take the process of protocol analysis as a series of operations that specify the mental activities in ever finer detail (e.g., Carroll & Johnson, 1990; Ericsson & Simon, 1984).

One concern over the abstraction process described here is the reliability of the process. The more abstractly the findings are represented, the more likely the findings will be relevant to domains other than the one under study, and thus potentially the greater the value of the field study. However, the abstraction process is essentially inductive, and different ways of providing supports to the abstraction process have to be used. One way, which has been used in several studies (e.g., Hollnagel et al., 1981; Moray, Sanderson, & Vicente, 1992), including ours, is to conduct different types of studies. Another way is to use the findings (i.e., the final product of the abstraction process) to re-interpret the field data, to find examples to substantiate the findings, and possibly to modify and enrich the findings in the process. Figure 2 is a framework adapted from Hollnagel et al. (1981), which was used in our field study.

Figure 2: The nature of data analysis in field studies



Interpretation

In our study, we also found that it was helpful to establish the explicit linkage between field data and findings through several levels of abstraction. Table 1 is a summary of the findings of our field study on problem solving strategies in the domain of anesthesiology. At the bottom level, the findings are represented by domain strategies (or "performance fragments," as defined by Hollnagel et al., 1981, p. 10). Findings represented at this level can be detected directly in the data collected from the field. In turn, these findings are difficult to generalize to domains outside anesthesiology, as they do not reveal the underlying cognitive activities. After removing the domain context and adding in cognitive descriptions, the domain strategies can be represented by specific strategies at the middle level. These strategies are no longer context specific, and thus cannot be verified directly by empirical data. Instead, they can be "illuminated" by examples in the empirical data. However, findings represented at this level have wide implications in terms of design and training. At the top level, specific strategies can be synthesized into a single generic strategy, which attempts to represent a fundamental characteristic in the interaction between proficient workers and complex, dynamic task environments. The generic strategy can direct the search for other kinds of specific strategies.

Levels of abstraction	Findings
Generic strategy	• Reduce response complexity through anticipating future situations, mental preparation, and reorganizing the physical workspace
Specific Strategies	• Schedule tasks (off-load) • Build local models and rules • Be preventive: think of probable side effects, pitfalls and predictors of these side effects • Prepare necessary materials and access • Rehearse pending procedures (mental simulation)
Domain strategies extracted from field data	• Prepare induction and emergency syringes • Pay more attention to muscle relaxation • If blood pressure fluctuates too wildly, start nitroglycerin infusion • Prepare nitroglycerin whenever there is a chance • Tape vaporizers to prevent the use of vaporizers (in a total intravenous anesthetic) • Use only short acting drugs if surgery duration is uncertain

Table 1: Findings represented at different levels of abstraction.

Conclusion

Field studies differ from laboratory studies in a number of important and fundamental aspects. It is these differences that not only warrant both types of studies, but also call for different ways of conducting and evaluating each. The well-established experimental study paradigm can become a limit on what types of data that one can use in the analysis.

To fully exploit the advantages of field studies, it would be profitable to set one's goal as the discovery of underlying cognitive strategies that are used by practitioners. This process could be assisted by the abstraction approach, which takes the field data as fragments of performance and aims at generic strategies that are case- or even domain-independent. This approach not only allows flexibility in terms of data collection and analysis, it could also make the process of field study more tractable.

References

Amalberti, R., & Deblon, F. (1992). Cognitive modeling of fighter aircraft process control: A step towards an intelligent onboard assistance system. *International Journal of Man-Machine Studies, 36*, 637–671.

Carroll, J. S., & Johnson, E. J. (1990). *Decision research: A field guide*. Newbury Park, CA: Sage.

Ericsson, K. A., & Simon, H. A. (1984). *Protocol analysis: Verbal reports as data*. Cambridge: MIT.

Hollnagel, E., Pedersen, O. M., & Rasmussen, J. (1981). *Notes on human performance Analysis*. Tech. Rept. Riso-M-2285. Riso National Laboratory, Roskilde, Denmark.

Hutchins, E. (1980). *Culture and inference: A Trobriand case study*. Cambridge: Harvard University Press.

Klein, G. A., Orasanu, J., Calderwood, R., & Zsambok, C. E. (Eds.). (1993). *Decision making in action: Models and methods*. Norwood, NJ: Ablex.

Moray, N. (1992). Toward an agenda for error research. In *Proceedings of Human Factors Society 36th Annual Meeting* (pp. 640–643). Santa Monica: Human Factors Society.

Moray, N., Lootsteen, P., & Pajak, J. (1986). Acquisition of process control skills. *IEEE Transactions on Systems, Man, and Cybernetics, SMC-16*, 497–504.

Moray, N., Sanderson, P. M., & Vicente, K. J. (1992). Cognitive task analysis of a complex work domain: a case study. *Reliability Engineering and System Safety, 36*, 207–216.

Neisser, U. (1976). *Cognition and reality—Principles and implications of cognitive psychology*. New York: W. H. Freeman.

Rasmussen, J. (1976). Outlines of a hybrid model of the process plant operator. In T. B. Sheridan & G. Johannsen (Eds.), *Monitoring behavior and supervisory control* (pp. 371-382). New York: Plenum.

Rasmussen, J., Pejtersen, A. M., & Goodstein, L. P. (1994). *Cognitive systems engineering*. New York: Wiley.

Sheridan, T. B., & Hennessy, R. T. (Eds.). (1984). *Research and modeling of supervisory control behavior: Report of a workshop*. Washington, DC: National Academy Press.

Woods, D. D. (1993). Process tracing methods for the study of cognition outside of the experimental psychology laboratory. In G. A. Klein, J. Orasanu, R. Calderwood, & C. E. Zsambok (Eds.), *Decision making in action: Models and methods* (pp. 228-251). Norwood, NJ: Ablex.

Xiao, Y. (1994). *Interacting with complex work environment: A field study and a planning model*. Ph.D. thesis, University of Toronto, Toronto, Ontario, Canada.

Xiao, Y., Milgram, P., & Doyle, D. J. (1993). Two classes of problem solving situations in managing complex systems. In *Proceedings of Human Factors and Ergonomics Society 37th Annual Meeting* (pp. 529–533). Santa Monica, CA: Human Factors and Ergonomics Society.

Xiao, Y., Milgram, P., & Doyle, D. J. (1997). Capturing and modeling planning expertise in anesthesiology: Results of a field study. In C. Zsambok & G. Klein (Eds.), *Naturalistic decision making* (pp. 197-205). Hillsdale, NJ: LEA.

Author Note

Yan Xiao, PhD is an Associate Professor of Anesthesiology and Information Systems, and he is the Director of Human Factors and Technology Research at the University of Maryland, Baltimore, MD. He may be contacted at 10 South Pine Street, Room 534, Baltimore, MD, 21201; Phone: 410-706-1859; yxiao@umaryland.edu.

Paul Milgram, PhD is an Associate Professor in the Department of Mechanical and Industrial Engineering at the University of Toronto in Toronto, Ontario, Canada. He may be contacted at the Department of Mechanical and Industrial Engineering, University of Toronto, 4 Taddle Creek Road, Toronto, Ontario, Canada, M5S 3G8; Phone: 416-978-3662; E-mail: milgram@etclab.mie.utoronto.ca.

The research was supported by an IBM Canada Doctoral Fellowship and NSERC Research Grant #OGP0004101. The writing was partially supported by ONR Grant #N00014-91-J-1540. The authors are grateful for the inputs and suggestions of John Doyle and Kim Vicente.

Author Citation

Xiao, Y., & Milgram, P. (2003). Dare I embark on a field study? Toward an understanding of field studies. *The Qualitative Report*, 8(2), 306-313. Retrieved [Insert date here], from http://www.nova.edu/ssss/QR/QR8-2/xiao.pdf.