In at the deep end: Contextual Inquiry and DiCoT as "flotation aids" for a novice ethnographer

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Abstract

Systematic approaches to observation and analysis have the potential to support a junior analyst in making sense of a complex setting. However, the costs and benefits of learning and applying such approaches have rarely been studied explicitly. In this paper, we present an idiographic study in which a single individual systematically learned and applied Contextual Inquiry and DiCoT (a structured approach to analyzing a system in terms of Distributed Cognition) to understand how anesthetists use infusion devices in their work. We present a reflexive account of his experiences. Contextual Inquiry was found to be a valuable tool for understanding this complex system; DiCoT built on that analysis to deliver rich insights into the design of tools and how information is exchanged around the system.

Author Keywords

Medical device, distributed cognition, contextual inquiry, anesthesiology, anaesthesia, DiCoT, ethnography.

Introduction

Entering an unfamiliar and complex system such as an operating theatre can be daunting for anyone, but particularly for a junior researcher who has limited prior experience of conducting observational studies and no formal training in surgery or anesthesia. However, there is often little choice but to prepare as well as

possible and then "dive in at the deep end". Ethnography as described by, for example, Randall and Rouncefield [7] offers little inherent support for the novice analyst in terms of what to pay attention to or how to record observations. Contextual Inquiry (CI [1]) provides guidance and a set of representations, particularly tailored towards understanding work with technology with a view to redesigning that technology. However, CI has no explicit theoretical basis. DiCoT [3] builds on CI representations, explicitly considering the sociotechnical system in terms of Distributed Cognition [4]. The question addressed in this study was: what does it take for a novice to learn and apply each of CI and DiCoT in a complex healthcare setting, and what kinds of insights does each approach afford?

Background

CI [1] is an approach to requirements gathering based on contextual observations and interviews that take place within the working context. Data is gathered in order to construct five kinds of work model for each interviewee: a flow model showing overall workflow; sequence models describing task structures; artifact models describing the objects that support work; a cultural model showing relationships between and influences on actors; and a physical model highlighting important features of the physical workspace. Following all data gathering, the models for individual participants are aggregated into general models that represent key features of the work, work context and artefacts. Although CI is an established method for requirements gathering, there are few reports on its application in healthcare.

Distributed Cognition (DCog [4]) is an approach to analyzing complex sociotechnical systems in terms of information propagation and transformation within a system, focusing on how the design and use of artefacts mediate work. DCog has been applied, and shown to deliver valuable insights, in a variety of healthcare settings, such as hospital resource management [5] and intensive care [6]. However, the classical accounts of DCog provide little methodological support for the novice analyst. To address this, Furniss and Blandford [3] developed DiCoT as a semi-structured approach to analyzing a system in DCog terms. DiCoT exploits representations from CI by overlaying them with a set of interpretive concepts and principles against which a system is assessed. For example, the concept of an "information hub" (within the information flow model of CI) highlights an actor or artefact within the system that aggregates and transforms information from different sources. An associated principle is that communication channels between a hub and the information resources on which he/she/it relies need to be reliable and effective. There have been no previous studies of the learnability of DiCoT, or of what added value this theoretical perspective might bring to the analysis of a complex healthcare system.

Method

This study was idiographic [8]. It involved one individual (EB) systematically learning and applying first CI and then DiCoT in the observation of the work of anesthetists, with a particular focus on their use of technology and how the current technology design supports or impedes their practice. DF took the role of principal tutor, guiding EB on the application of CI and DiCoT as required. AB oversaw the study. All authors had regular scheduled meetings.

Since DiCoT exploits CI representations, CI was learned first. Five weeks were allocated to learning and applying CI, then five further weeks to learning and applying

DiCoT. Six observational sessions were completed during the first phase and five during the second. Each involved detailed observation of one operation, typically taking 3-5 hours. The focus was on information interaction and technology use, particularly on the design and use of infusion devices. EB maintained a detailed diary of activities, difficulties, insights and findings, including detailed notes of discussions. These formed the basis for a thematic analysis [2] of the experience and outcomes of learning and applying CI and DiCoT. While a single case study may not generalize, it permits insights if a kind that are not available from broader nomothetic studies.

Findings: learning
EB spent a week learning CI before feeling ready to start data gathering; he took a further two weeks to achieve a comparable level of confidence in DiCoT. A core text book [1] was used as the principal reference for CI; this included illustrative examples that supported understanding (although they proved to be insufficiently detailed or complex to adequately support the transition into the study setting). In contrast, information about DiCoT was scattered across several papers, and the approach had been adapted to fit each new context in which it had been applied. These earlier studies provided examples that had a similar level of complexity to the study setting; however, DF's guidance proved essential to enable EB to achieve a coherent understanding of the approach. EB drew on his prior education in psychology for scaffolding his learning of DCog.

Findings: CI and DiCoT as "flotation aids"
EB found it necessary to spend an "orientation week" in the study setting prior to any data gathering because it proved too challenging to both make sense of the work practices and apply any modeling approach initially.

Following the orientation week, EB found the flow model of CI invaluable for understanding the workflow of the operating theatre: it enabled EB to structure his observations and identify generalizations across a set of instances. For example, making a distinction between two groups of actors (surgeons and anesthetists) made it easier to subsequently focus attention on the group of interest – namely, the team of anesthetists. CI also encouraged a focus on artefacts and how their design facilitated information flow. Guidance from [1] on achieving an appropriate level of abstraction in the modeling helped EB to focus on elements of the system that were relevant to anesthetists' work, minimizing distractions from other parts of the complex work system. However, EB did not identify any significant or systematic problems with either overall information flow or the detailed design of infusion devices through the application of CI.

The DiCoT concepts and principles helped to identify a range of issues relating to both information flow and device design. For example, recognizing the roles of anesthetists as *information hubs* and the importance of maintaining *situation awareness* highlighted the ways in which they integrate information from surgeons, monitors, each other, and various other sources (external to our analysis) to maintain a coherent picture of the state of the patient as a basis for care management. The analysis also highlighted problems associated with shift changes and reduced *communication bandwidth* within the team when one of the anesthetists needed to leave the operation theatre.

As well as drawing attention to such issues, the DiCoT analysis helped to identify vulnerabilities in the design of the infusion devices being used. For example,

feedback from the device during the setup procedure was limited, which could make it difficult for an anesthetist to resume programming correctly after an interruption. This possibility had not previously been mentioned by participants.

Discussion

This study inevitably has limitations, being based on the activities and reflections of one individual. It was possible to conduct this study because EB joined our lab as an intern with relevant prior knowledge (of HCI and psychology) and with a strong interest in healthcare, but without prior knowledge of either CI or DCog; these are relatively unusual circumstances, making it difficult to replicate the study to assess the generalizability of the findings. Nevertheless, the systematic, in-depth approach taken has yielded valuable insights. Trivially, EB's experience of learning the two techniques highlights the value of good learning resources for any novel theory or method and the value of a background in psychology for understanding DCog. More significantly, the theoretical concepts and principles of DCog encapsulated within the DiCoT method helped to identify issues that might never have been observed, or might have passed unnoticed, without this theoretical framework. CI models delivered a good basic understanding; the additional theoretically based scaffolding provided by the DiCoT concepts and principles supported EB in identifying a range of issues concerning information flows and technology design in anesthesia. To return to our metaphor: CI served as a basic flotation device to help the novice ethnographer "keep his head above water"; DiCoT propelled him forward to achieve insights that would almost certainly have evaded him in the available time without such support.

Acknowledgements

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