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A cognitive blueprint of collaboration in context: Distributed cognition in the psychiatric emergency department

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Summary

Objective: The complex cognitive processes that underlie human performance in 'messy' contexts such as critical care medicine suggest a need for a cognitive model with broad scope to support the understanding of error in such domains. The objective of this research is to characterize the cognition that underlies patient care in the domain of emergency psychiatry in order to enhance the understanding of error in this context.
Methods and materials: The theoretical framework of distributed cognition has been used to study collaborative decision-making in a number of similarly complex environments such as airline cockpits and air traffic control towers. These environments share certain characteristics with the critical care domain: the work is collaborative in nature, it is supported by artifacts that can be studied directly, and the consequences of error are dire. However, the nature of the work in this domain and the artifacts used to support it are unique. The application of the theoretical constructs of distributed cognition to this context is necessary in order to characterize the collective thinking that underlies critical care. Our research uses a combination of ethnographic and interview data to derive a distributed cognitive model of the psychiatric emergency department (PED), a high volume clinical unit dealing exclusively with the acute phases of psychiatric crises. The dynamics of workflow within the department are complex: several types of clinician collaborate by forming temporary multidisciplinary teams that attach to and manage particular patients. The component members of these teams change over time.

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Results: Using the theoretical framework of distributed cognition, we interpreted the collected data to derive a cognitive model of the distribution of work and information flow in the PED. This modeling process has revealed several latent flaws in the system related to the underlying distribution of cognition across teams, time, space and artifacts.
Conclusions: The characterization of this distribution has enhanced our understanding of the cognitive dynamics underlying error in this environment, and will serve to guide future research on error management in the ED and inform the development of context-appropriate error-management systems.

1. Introduction

Early work in artificial intelligence in medicine (AIM) concerned itself with the design of systems to perform the complex diagnostic and therapeutic tasks of individual expert clinicians. However, the intelligence that supports critical care work cannot be captured by focusing on the thought process of any one individual, as this work is inherently collaborative. Rather than existing in the mind of any particular individual, the cognition in critical care settings can be characterized by its distribution across the minds of members of the clinical team and across physical media such as clinical notes [1]. In a historical review of artificial intelligence in medicine, Coiera suggests that in order for the field to be relevant to clinical medicine, it must adopt clinical medicine's goals as its own [2]. The alternative, an inward-looking approach in which research is conducted in isolation from the concerns of related fields is characterized by Shortliffe as 'adolescent' [3]. The recent Institute of Medicine (IOM) report [4] has drawn considerable attention to the issue of error in medicine. This particular issue cannot be addressed without deep knowledge of the environment in which errors occur. Furthermore, designers of new technological artifacts to address such issues must take into account the pre-existing distributed cognitive structures that support the process of care. The design of systems that are clinically relevant requires an awareness of the real-world distribution of cognitive work, as it is into this environment that an artificial agent will need to be integrated. Rather than isolated individual intelligence, it is the distribution of intelligence across team members and artifacts that will reveal opportunities for the design of contextually relevant technology. In summary, the relevance of AIM to the field of medicine requires the development of contextually relevant solutions to problems that concern clinicians.

In this research we use the framework of distributed cognition to characterize the cognition that underlies clinical care in the psychiatric emergency department (PED), in order to reveal underlying systemic mechanisms of medical error. Distributed cognitive research has revealed much about how things work in complex collaborative settings [5,6]. Recent research applying this framework to critical care settings has focused on the mediating role of cognitive artifacts in supporting clinical care, and suggested that the design of information technology interventions should take into account the effectiveness of pre-existing supportive artifacts [1]. While we recognize the critical role of such artifacts in supporting clinical work, the specific aim of this research is to identify features of the distributed cognitive system that may be conducive to error. This decision was motivated by a pressing need in the medical community to understand and prevent error in the wake of the IOM report [4].

Reason defines error as the failure of a planned sequence of mental or physical actions to achieve the intended outcome when this failure cannot be attributed to chance [7]. Most errors do not result in patient injury [8]. However, errors represent the preventable component of the causal pathway leading to adverse events. An understanding of the underlying mechanisms of error is essential if we are to design systems to protect patients from these events. Zhang et al. reveal the fundamental role of cognition in the understanding of such mechanisms [9], proposing a theoretical framework that could be used to classify errors by constructing a taxonomy with explanatory and predictive power. This framework incorporates the role of cognition at each level of the healthcare systems hierarchy, and is therefore applicable to study of the systemic features underlying medical error. Reason refers to "latent conditions" [7] to denote the potential for errors that exists within complex systems. For example, communication failures were found to contribute to 91% of medical mishaps investigated by Sutcliffe et al. [10]. The study of error without an understanding of the context in which it occurs is unlikely to reveal the potentially remediable systemic factors that lead to error. Much error research has involved retrospective analysis of case reports [11–14]. However, this approach is vulnerable to bias (if a clinician involved with a particular case