



## Visual overview, oral detail: The use of an emergency-department whiteboard<sup>☆</sup>



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### ABSTRACT

Whiteboards facilitate coordinative practices by making information publicly accessible and thereby strengthening communication and joint commitment about it. This study investigates how coordination is accomplished in an emergency department through interactions with the whiteboard and with the coordinating nurse, who is the main keeper of the whiteboard. On the basis of observations, we find that coordination is accomplished through a highly intertwined process of technologically mediated visual overview combined with orally communicated details. The oral details serve to clarify and elaborate information at a more fine-grained level than the overview information on the whiteboard, to negotiate and reach agreement about the decisions that underlie the whiteboard information, and as a safeguard against misunderstandings and errors. This process is contingent on the clinicians tending to perceive the whiteboard and the coordinating nurse as a unit in the sense that they frequently update the whiteboard by informing the coordinating nurse about the change and, similarly, consider making a change on the whiteboard the same as having informed the coordinating nurse. These smooth transitions between instrumental and communicative coordination are central to the coordinative function of the whiteboard. We discuss this and other implications for design.

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### 1. Introduction

Whiteboards serve a coordinative function in much cooperative work by publicly displaying information and facilitating communication about it for purposes such as joint planning and rescheduling (Tang et al., 2009; Whittaker and Schwarz, 1999; Xiao et al., 2001). Their coordinative function makes whiteboards important artifacts because coordination is central to cooperative work and a frequent cause of breakdowns. While shared whiteboards provide access to whiteboard content and opportunity for updating it, it is less clear how the content remains current, attended to, understood, and acted on. To understand this, multiple studies have investigated the work practices associated with whiteboards (e.g., Aronsky et al., 2008; Tang et al., 2009; Whittaker and Schwarz, 1999). In emergency departments (EDs), whiteboards are integral to the continuous coordination of work (Bjørn and Hertzum, 2011) and their coordinative function is tightly coupled with the work of the coordinating nurse (Hertzum and Simonsen, 2013). To avoid errors with potentially adverse effects on patient health, the coordinative practices

associated with ED whiteboards must be sufficiently robust to withstand the dynamic, sometimes hectic, ED environment.

In this study we investigate how coordination in an ED is accomplished through interactions with the whiteboard and with the coordinating nurse. We argue, on the basis of workplace observations, that these interactions form a highly intertwined process of technologically mediated visual overview combined with orally communicated details. In short: visual overview, oral detail. Our distinction between interactions with the whiteboard and with the coordinating nurse corresponds to distinctions between instrumental and communicative coordination (e.g., Bardram, 2000). We employ the analytic distinction between instrumental and communicative coordination to show how entangled visual overview and oral detail are in practice. We find, indeed, that the ED clinicians tend to perceive the whiteboard and the coordinating nurse as a unit, rather than as two separate entities. This perception shows how a focus on the whiteboard in isolation is insufficient to understand its coordinative function and leads to a discussion of the coordinative unit consisting of the whiteboard and the coordinating nurse. Our argument can be seen as a cooperative-work note on, or qualification of, Shneiderman's (1996) visual information-seeking mantra ("Overview first, zoom and filter, then details-on-demand"), which presupposes that both overview and details are mediated through instrumental coordination.

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In the next section, we describe related work on the coordinative function of whiteboards and elaborate the distinction between instrumental and communicative coordination. Section 3 accounts for the method of our study, which is based on observations at the ED of a Danish hospital. We present our results in Section 4 by showing how the ED clinicians maintain an overview and obtain associated details through interactions with the whiteboard and the coordinating nurse. Section 5 provides a discussion of the intertwined process of visual overview and oral detail, and discusses implications of this process for the design of systems intended to support cooperative work.

## 2. Related work

Shneiderman (1996) presents his visual information-seeking mantra as a guideline for how to design visual interfaces. The mantra, “Overview first, zoom and filter, then details-on-demand”, recommends that designers should provide users with an initial overview of the information space and that details should be postponed until users request them. Systems that apply the mantra include Lifelines (Plaisant et al., 1996), which visualizes personal histories as timelines with icons indicating individual events and possibilities for zooming in on specified time periods and for viewing details about specified events. While the data visualized in Lifelines, for example a person’s medical history, have been entered by multiple people, the Lifelines system focuses on how to present the data visually to a single user working alone. This focus is consistent with the mantra, which neglects cooperation and is restricted to visual means of conveying information. These limitations are not specific to the mantra but appear characteristic of the ways in which the notion of overview is conceptualized in information-visualization research (see, Hornbæk and Hertzum, 2011).

In contrast, whiteboards exemplify a type of system that supports cooperating actors in their coordinative practices and in maintaining an awareness of the state of their joint work. Studies of such real-time coordination have shown how co-located actors render aspects of their activities visible in order to have others notice and align with actions and events that might otherwise pass unnoticed (e.g., Heath and Luff, 1992; Hutchins, 1995; Mackay, 1999). When actors are locally mobile within a workplace, such as a hospital, they cannot rely exclusively on oral communication, gazes, and other ephemeral means of coordination. They need artifacts that can, temporarily, hold information and thereby make it visible to others (Whittaker and Amento, 2003). Whiteboards are widely used for this purpose, partly because they afford making information visually accessible in or near the place where it is needed (Tang et al., 2009).

Whittaker and Schwarz (1999) found that a dry-erase whiteboard located in a public area induced commitment, responsibility, and frequent updates among project participants, who used the whiteboard for collaborative problem solving and project scheduling. The project participants would often gather at the whiteboard to sort things out. Xiao et al. (2001) made similar observations and noted that the sheer size of the studied whiteboard accommodated groups of people standing close to the whiteboard, either discussing or modifying its contents. Cherubini et al. (2007) found that for all the studied purposes of whiteboard use more than half of the survey respondents indicated that multiple people would gather at the whiteboard, thereby emphasizing its collaborative and coordinative function. The purpose with the highest percentage of individual whiteboard use (~40%) was ‘understanding’, suggesting that details were often worked out individually rather than collaboratively. In relation to overview, Hertzum (2011) reported that the replacement of dry-erase with electronic whiteboards at an ED resulted in an improvement in the clinicians’ self-reported overview of their work.

Whiteboards are an example of transitional artifacts, which fill a gap between the work being performed and the formal documentation of it in, for example, electronic patient records (Chen, 2010). Electronic patient records support the mandatory documentation of clinical assessments, completed treatments and so forth. Transitional artifacts hold procedural information, present information in accordance with local workflows, or otherwise facilitate the flow of work in ways not done by the formal documentation. Most electronic ED whiteboards resemble dry-erase whiteboards in content and visual layout (Rasmussen, 2012). Both types of whiteboard have a matrix layout with a row for each patient and columns with key information, such as room, patient name, chief complaint, triage level, responsible nurse, and tests ordered. In contrast to the text-oriented whiteboards in EDs, electronic whiteboards in surgical suites have been augmented with live video feeds, which show the spatial location of clinicians, indicate how far surgical procedures have progressed, and thereby provide an awareness that facilitates the coordination of upcoming activities (Bardram et al., 2006; Hu et al., 2006). The transitional nature of whiteboards also means that they are more often glanced at in passing than scrutinized in detail (Lederman and Johnston, 2011) and that they benefit from being centrally located in a department to invite at-a-glance use and information exchange with colleagues (Scupelli et al., 2010).

France et al. (2005) found that an electronic ED whiteboard improved the efficiency of work and communication among the physicians and attributed this improvement to a reduced need for interrupting each other because information previously obtained from colleagues had become available on the whiteboard. This study suggested that the introduction of a whiteboard reduced interruptions and oral communication and, thereby, physicians’ mental workload. Along similar lines, Aronsky et al. (2008) emphasized that electronic ED whiteboards can provide rapid access to more detailed information by retrieving it from the electronic patient records. Wong et al. (2009) reported that a newly introduced whiteboard brought together information that was previously distributed across multiple people and records. As a result, the clinicians experienced time savings and improved communication. These three studies suggest a reduced need for obtaining information orally because electronic whiteboards make more information readily available.

While the studies mentioned above reported positive effects of whiteboards, other studies have found that the introduction of electronic whiteboards in healthcare settings affected workflows negatively (Pennathur et al., 2007), made clinicians work more individually (Wears et al., 2003), and contained less information relevant to patient treatment (Bisantz et al., 2010). Thus, it is not clear how whiteboard users balance information exchange via the whiteboard against oral information exchange directly with their colleagues. Bardram (2000) conceptualized this balance by distinguishing between instrumental and communicative coordination. Instrumental coordination is mediated by artifacts that temporarily hold information and, for example, includes using a column on a shared whiteboard for holding information about when a patient is ready for transfer to another department, thereby mediating the coordination between the sending department, the receiving department, and the porters physically transferring the patient. Communicative coordination takes place when actors coordinate their activities face to face or by means of communication technologies, which transmit but do not hold information. A nurse may, for example, phone another department and negotiate a time for the transfer of a patient.

Carstensen and Nielsen (2001) compared and contrasted the communicative coordination in maritime navigation with the instrumental coordination in software engineering. In these settings, communicative coordination relied on the use of sentential schemas, which reduced the role of the uttered words to that of providing the

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