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How do interruptions affect clinician performance in healthcare? Negotiating fidelity, control, and potential generalizability in the search for answers



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ABSTRACT

Interruptions and distractions are a feature of work in most complex sociotechnical systems in which people must handle multiple threads of work. Over the last 10–15 years there has been a crescendo of reviews and investigations into the impact that interruptions and distractions have on safety-critical aspects of healthcare work, such as medication administration, but findings are still inconclusive. Despite this, many healthcare communities have taken steps to reduce interruptions and distractions in safety-critical work tasks, a step that will usually do no harm but that may have unintended consequences. Investigations with a higher yield of certainty would provide better evidence and better guidance to healthcare communities. In this viewpoint paper we survey some key papers reporting investigations of interruptions and distractions in the field, in simulators, and in the laboratory. We also survey reports of field interventions aimed at minimizing interruptions and distractions with the intention of improving the safety of medication administration and other safety-critical healthcare tasks. To analyse the papers adopting each form of investigation, we use the three dimensions of fidelity, formal control exercised, and the potential generalizability to the field. We argue that studies of interruptions and distractions outside the healthcare clinical context, but intended to generalize to it, should become more formally representative of the cognitive context of healthcare work. Research would be improved if investigators undertook programs of studies that successively achieve fidelity, control, and potential generalizability, or if they strengthened the design of individual studies.

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1. Introduction

1.1. The problem

Work in complex sociotechnical systems is usually multiply-threaded. There have been many treatments of this issue in aviation, process control, and air traffic control (Colom et al., 2010; Loukopoulos et al., 2009; Mumaw et al., 2000; Wickens, 2002). Over the last 10–15 years, concerns about some of the consequences of multiply-threaded work have emerged in the healthcare domain. Specifically, there has been a crescendo of empirical research as well as literature reviews on workplace interruptions and distractions in healthcare.

There are two main factors driving these concerns. First, the interest stems from healthcare workers' subjective responses to the interruptions and distractions they experience, including an increase

in subjective workload and a sense of frustration. Second, there is the concern that interruptions and distractions may lead to errors in the performance of healthcare tasks, which may in turn cause harm to patients. For both reasons, researchers and practitioners have sought (1) to uncover the burden of the problem of interruptions and distractions in healthcare, and (2) to design and evaluate interventions to reduce the burden.

1.2. Goal of paper

Our goal in this viewpoint paper is to survey the methods that researchers have used to study interruptions and distractions in healthcare, highlight cases of exceptionally good practice, and reflect on how empirical investigations might deliver more value with respect to (1) and (2) above. We are not attempting an exhaustive review and methodological classification of all investigations in the area, but instead we have selected important and influential studies that help us to illustrate the points we wish to make.

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2. Interruptions in healthcare

2.1. Definitions of interruptions and distractions

Up to this point we have used the phrase “interruptions and distractions” to characterize the topic of this paper because most of the healthcare literature refers to “interruptions and distractions”. Within healthcare research there is some use of the term “multitasking” (Chisholm et al., 2000; Laxmisian et al., 2007; Walter et al., 2013) where it tends to refer to the clinician’s management of, and switching between, multiple threads of responsibility, rather than the clinician’s timesharing or rapid switching between tasks at a molecular level. Using Salvucci et al. (2009) multitasking continuum, *sequential* multitasking and switching from one responsibility to another is usually the concern in healthcare (Walter et al., 2013), rather than *concurrent* multitasking. Sequential multitasking is more likely to be recorded as task switching in response to a series of interruptions. Concurrent multitasking at the most molecular level is usually not a favoured strategy for handling multiple threads of responsibility, given the safety-critical nature of healthcare tasks, unless cognitive resource demands make it possible (Wickens, 2002). Concurrent multitasking is often recorded as a kind of distraction.

A further concern is that the terms “interruption” and “distraction” cannot refer *a priori* to certain classes of external events, because both terms require observation of a person’s reaction before they can have meaning. Under most definitions (see below), requesting a person’s attention (via a vocal request, via equipment alarm, via phone, via personal proximity) becomes an interruption only if the person ceases activity on their current task for a measurable amount of time. Similarly, a noisy background conversation or event becomes a distraction only if there is a measurable effect on a person’s performance.

Within the healthcare literature there has been considerable variation in how interruptions and distractions are defined and how they are distinguished operationally during empirical investigations (for some examples of differences in definitions, see Grundgeiger and Sanderson, 2009; Sasangohar et al., 2012). For present purposes, and as implied above, we say that an interruption occurs when an event leads a person to remove their attention fully but temporarily from a primary, or current, task to another task, and then move their attention back to the primary task. An example is an intensive care nurse suspending a patient assessment while countersigning a medication order. We say that a *distraction* occurs when a person’s attention is partially diverted from a primary task to another task but performance on the primary task is not fully suspended. An example is responding vocally to questions while performing a manual medical procedure. If the other task is sustained, we may talk of *multitasking*. Note that the definitions do not take into account the content, convenience, and usefulness of the two tasks. In the extreme, clinicians may not even consider events such as those described above as interruptions or distractions, because their content progresses clinical work.

Most of the research on interruptions and distractions in healthcare has been performed with doctors or nurses as participants. In what follows, when referring to healthcare participants in general we will use the term “clinicians” to cover both disciplines. By “clinicians” we refer to the fact that the doctors and nurses are working in a clinical context, which is usually a hospital.

2.2. Forms of investigation

Three key motivations for investigating interruptions and distractions in healthcare are to determine the burden they pose on clinicians, to identify whether and when they cause harm to patients, and to test interventions intended to reduce any such harm. Investigations that are informative for healthcare have generally taken one

of four forms: (1) field investigations, (2) simulator-based investigations, (3) laboratory-based investigations, and (4) intervention studies. In this section we provide a brief overview of these general forms of investigation before introducing the conceptual framework that we will use to highlight methodological issues.

Field investigations take place in clinical contexts with clinicians as participants. They can have an ethnographic motivation (Colligan and Bass, 2012; Rivera, 2014), they can be focused on identifying and classifying activity (Berg et al., 2013; Trbovich et al., 2013; Weigl et al., 2011; Westbrook et al., 2010) or they can require clinicians to keep a diary (Baethge and Rigotti, 2013). A frequent motivation underlying field studies has been to identify the burden that interruptions and distractions impose on clinicians by collecting information on how often and under what conditions they occur. More rarely, field investigators collect information on the motivations of interrupters (Rivera, 2014) on the correctness of clinical procedures and on episodes of actual or potential harm, and they seek associations between interruptions and distractions and non-nominal behaviour or events (Westbrook et al., 2010).

Simulator-based investigations take place outside the context of delivering care to live patients. They help investigators clarify the conditions under which interruptions may or may not produce harm. Simulator-based investigations may be mounted in a full-scale healthcare simulation environment (Feuerbacher et al., 2012; Liu et al., 2009; Prakash et al., 2014) or in a part-task simulation environment (Magrabi et al., 2010). They typically involve clinicians as participants. As a form of investigation, simulator-based investigations show greater variety than either the field or laboratory-based investigation because they loosen the constraints both of the field and of the laboratory. By offering the opportunity for control in a safe environment, they not only help investigators clarify the conditions under which interruptions might produce harm, but also offer the opportunity to test interventions that might reduce harm.

In contrast to both field and simulator-based investigations, laboratory-based investigations involving interruptions have generally not been motivated by the practical problem of interruptions in healthcare, although investigators sometimes make claims about the potential generalizability of their results to such problems (Monk et al., 2008). Instead, laboratory-based investigations are generally performed to develop and test cognitive theories and models relating to memory and attention (for example, Altmann and Trafton, 2002; Dismukes and Nowinski, 2007). In laboratory experiments, factors such as the exact time of arrival of an interruption, its duration, any advance warning of the interruption, the availability of visual cues relating to the original task, and so on, have been manipulated to distinguish different theories and build effective models. Nonetheless, some laboratory tasks offer findings that can be useful for healthcare if a case can be made for the generalizability of the findings.

To date, most intervention studies relating to interruptions in healthcare have taken place in the field, but field interventions can also be supplemented by trial interventions in a simulator context or even a laboratory context, in preliminary evaluations of effectiveness. Rather than seeking to establish relationships between interruptions and distractions and patterns of work in the field, intervention studies test the effectiveness of a workplace design (a novel workplace practice or device) that represents a hypothesis about how work practice and outcomes might be improved in a certain work context (Woods, 2003)

3. FCG cube

In this section we introduce the conceptual framework we will use to discuss methodological aspects of present research on interruptions and distractions in healthcare. As Brinberg and McGrath (1985)

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