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A socio-technical systems approach to studying interruptions: Understanding the interrupter's perspective

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ABSTRACT

The purpose of this study was to understand the cognitive processes underlying nurses' decision to interrupt other nurses. The Institute of Medicine (2000) reported that interruptions are likely contributors to medical errors. Unfortunately, the research to date has been quite homogenous, focusing only on the healthcare provider being interrupted, ignoring the true complexities of interruptions. This study took a socio-technical approach being the first to examine interruptions from the viewpoint of the interrupting nurse. Over 15 h of observations and 10 open-ended interviews with expert nurses in a Neuroscience Surgical Intensive Care Unit were conducted. It was found that nurses conduct a quick cost-benefit assessment to determine the interruptibility of other nurses and whether an interruption is value-added vs. non-value added. To complete the assessment, nurses consider several conditional factors related to the interruptee, the interrupter, and the nature of the interruption content, and different potential consequences of the interruption.

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1. Introduction

The study of interruptions in the domain of healthcare is relatively new, as compared to other domains such as aviation and driving. However, recently, the topic of interruptions has been heavily pursued by healthcare researchers (Coiera, 2012). This new interest is in part due to the Institute of Medicine's (2000) report which highlighted interruptions as likely contributors to medical errors. Unfortunately, the healthcare research to date has been quite homogenous in nature (Coiera, 2012; Rivera-Rodriguez and Karsh, 2010). The main focus has only been on the healthcare provider (HCP) being interrupted (i.e. the interruptee) and their experiences with and reactions to interruptions (Biron et al., 2009). This one-sided perspective on interruptions is a concern for several reasons. First, it does not capture the dual (interrupter–interruptee) complexities that Rivera-Rodriguez and Karsh (2010) identified when they depicted the varying outcomes (positive–positive, positive–negative, neutral–negative, etc) that the interruptee and interrupter can experience from any given interruption. Second, it tends to highlight the micro-cognitive elements related to interruptions (i.e., effects on the interruptee), while ignoring the socio-technical system implications that interruptions can have on the system (e.g., interruptions emerging from teamwork) (Rivera-Rodriguez and Karsh, 2010). Third, this approach only studies interruptions after they have already occurred. All of these limitations have cultivated insufficient interruption interventions which have focused on eliminating or reducing all interruptions (Anthony et al., 2010; Pape, 2003; Pape et al., 2005; Peleg et al., 2000; Relihan et al., 2009). These intervention strategies (e.g. orange vests to signify "interruption-free" zones) are troublesome because they do not fit with the workflow of the system (Karsh et al., 2006), many times resulting in non-value added interruptions themselves (e.g., putting on and taking off the vests). However, many interruptions are actually necessary (e.g. nurses calling another HCP when they need immediate help with their patient, patient monitors and intravenous pumps alarming to indicate a change in the patient's status). Researchers studying interruptions and developing interruption interventions in healthcare need to better understand the nuances that exist with interruptions in such complex systems (Rivera-Rodriguez and Karsh, 2010).

1.1. Socio-technical systems approach to studying interruptions

From a complex socio-technical systems perspective, interruptions can be thought of as one way in which two systems (made of inputs, transformations, and outputs) interact with one another (see Fig. 1) (Donabedian, 1979). With interruptions, one system (i.e. the interrupter) produces the interruption as an output and the other system (i.e. the interruptee) receives the interruption as an input (Rivera and Karsh, 2008). Past research has extensively

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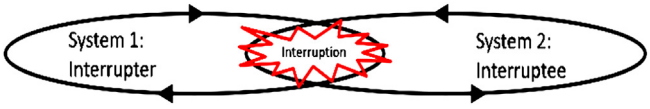

Fig. 1. Dual complexities of interruptions.

examined the latter system, only providing us with ex post facto information on interruptions. Little is known about the former system, the system that triggers the interruption process. Therefore, this study takes a first-of-its-kind look at interruptions by studying interruptions from the interrupter's point-of-view.

Studying this system (i.e. the interrupting agent) will allow us to understand interruptions from a completely different perspective—one that tries to understand the situation prior to an interruption occurring by understanding the cognitive processes (e.g., perceiving and assessing) underlying the decision to interrupt. This approach will facilitate our understanding of the dual-complexities and socio-technical influences of interruptions. This new understanding can help researchers develop interventions that are more compatible with HCPs' workflow and more beneficial to patient safety because they will be able to target non-value added interruptions for elimination while still facilitating value-added interruptions.

1.2. Purpose of study

In this study, an interruption was defined as an unplanned break in workflow caused by an external source (i.e. the interrupter). This definition is deliberately broad to encompass many of the definitions other researchers have used for interruptions (e.g., Coiera and Tombs, 1998; Flynn et al., 1999; Pape, 2003) and distractions (e.g., Healey et al., 2007), disruptions (e.g., Wiegmann et al., 2007), breaks-in-task (e.g., Chisholm et al., 2000), etc. Interruptibility (see research questions below) can be thought of as a combination of 1) how interruptible someone is based on the interruption's potential impact on their task performance, which takes into consideration their cognitive and social state; and 2) how interruptible someone is based on a conscious choice of their willingness to be interrupted (Grandhi and Jones, 2009).

This study, being the first to examine interruptions in this way, took an exploratory approach, to answer the following research questions (RQs):

- RQ 1: *How do nurses determine the interruptibility of other nurses?*
- RQ 2: *Which interruptions are perceived as warranted even if a nurse's interruptibility is determined to be low?*
- RQ 3: *How do nurses interrupt other nurses?*

Table 1
Study setting and population demographics.

Neuroscience Surgical Intensive Care Unit (NSICU)	
Number of beds	8
Typical patient occupancy	88%
Number of RNs	28
Typical shift schedule of nurses	Mix of 8 & 12 h shifts. Days = 7am-7pm, 7am-3pm, 3am-3pm PMs = 3pm-3am, 3pm-11pm Nights = 7pm-7am, 11pm-7am
Spread of RNs per shift	Day = 46% (n = 13) PM = 32% (n = 9) Night = 21% (n = 6) Note: These may not be exact numbers as some shifts overlap each other and nurses may vary in the shifts they work.
How many nurses with 3 or more years of experience on the unit?	19 (68%)
How many bedside nurses also play the role of Charge nurse?	21 (75%)
What type of health information technology did RNs interact with on unit?	Electronic health records (EHRs) including computer provider order entry (CPOE), and bar coding medication administration (BCMA)
Sample	
Experience of observed nurses (N = 5):	Average years as nurse = 24.6 (range 11–32) Average years as nurse on unit = 4.3 (range 4–4.5)[a]
Experience of interviewed nurses (N = 10):	Average years as nurse = 18.6 (range 4.5–40) Average years as nurse on unit = 4.3 (range 4–4.5)[a]

[a] NSICU became its own unit in January of 2007; previously it was combined with the Cardiovascular Intensive Care Unit.

2. Method

All procedures were approved by the Hospital's and University's Institutional Review Boards.

2.1. Study setting

This study was conducted in a Neuroscience Surgical Intensive Care Unit (NSICU) at a non-profit, 440-bed tertiary care hospital in the Midwest of the United States. With 1100 staff nurses, this hospital offers both inpatient and outpatient treatment and diagnostic services. An ICU within a hospital setting was purposively sampled over other healthcare settings (e.g., primary care, pharmacy) because interruptions occur more often in hospitals (Chisholm et al., 2001) and in ICUs (Alvarez and Coiera, 2005; Anthony et al., 2010). Table 1 shows the demographical statistics of the study unit and population.

2.2. Participants

Nurses within a critical care setting were purposefully selected as the healthcare provider of interest for this study. The focus was on the nurse-to-nurse dyad, concentrating on the interrupting nurse. Past research has highlighted that not only are nurses frequently interrupted (e.g., 16.7 interruptions per hour (Alvarez and Coiera, 2005)), but they are also cited as sources of interruptions (e.g., Friedman et al., 2005; Hedberg and Larsson, 2004; Kreckler et al., 2008). Furthermore, Brixey et al. (2008) and Edwards et al. (2009) revealed what a *significant role* nurses in hospital settings play as contributors of interruptions over other healthcare providers. They found that nurses initiated 36.16% (Brixey et al., 2008) and 41.50% (Edwards et al., 2009) of the observed interruptions.

Although interruptions are events that typically occur in hospital settings, they are not considered a part of the typical nursing work taught in school and nurse training. Therefore, the knowledge that is required to deal with interruptions is not covered in formalized procedures, but rather it is tacit knowledge that is developed over time and with experience (Klein et al., 1989). To target the tacit knowledge used to interrupt, and to reduce variability and increase methodological control, expert nurses were purposively sampled. This also means that all the results of this study are framed from the expert nurse's perspective. According to how Benner's (1982) study applied the Dreyfus Model of proficiency to nursing work, expert nurses for this study were defined as nurses with more than 3 years of experience on the NSICU.