The Design and Field Observation of a Haptic Notification System for Timing Awareness During Oral Presentations

by

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Abstract

Conference session chairs must manage time, usually by reminding speakers of the time remaining through a variety of means (e.g., visual signs with "X" minutes left). But speakers often miss reminders, chairs cannot confirm reminder receipt, and the broken dialogue can be a sideshow for the audience. The experience of speaking in front of an audience, such as at a conference or even during a classroom lecture, can also be cognitively demanding and overwhelming. This further causes speakers to miss reminders from personal timing tools (e.g., cellphone timer). To address these and other concerns, this thesis describes the design and evaluation of HaNS, a novel wireless wrist-worn chair-speaker Haptic Notification System, that delivers tactile timing alerts to unintrusively aid speakers and session chairs time-manage oral presentations. Iterative deployment and observation in realistic settings was used to optimize the attentional characteristics and the chair-speaker interaction. HaNS's use was then observed through four field observations in three settings: two mid-sized academic conferences (55 speakers, 16 session chairs, 50 audience members), five university research seminars (11 speakers, 5 session chairs, 15 audience members), and four large university lectures (23 by 3 instructors). Through observation and self-reports, existing speaker and session chair timing practices and difficulties are documented. Results demonstrate that HaNS can improve a user's awareness of time; it automatically delivers salient notifications, unintrusively, privately, and remotely. HaNS also facilitates chair-speaker coordination and reduces distraction of speaker and audience through its private communication channel. Eliminating overruns will require improvement in speaker 'internal' control, which our results suggest HaNS can also support given practice. This thesis concludes with design guidelines for both conference-deployed and personal timing tools, supported by haptics or other notification modalities.

Preface

The study in this thesis was conducted with the approval of the UBC Behavioural Research Ethics Board (BREB) under certificate number H11-03432.

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Dedication

To my family,

and *Laurence,*

for their continued love and support.

Chapter 1

Introduction

Conferences often begin with a welcome from the conference organizers, swiftly followed by an earnest plea to all of the speakers and the session chairs that oral presentations stay on time to avoid causing a cascade of delays in the program. The familiar situation of a speaker abruptly realizing that time is up and terminating his/her talk well before reaching the conclusions slide results in palpable discomfort for the audience and the speaker alike. Session chairs struggle when delays accumulate and they have to adjust question-and-answer periods on the fly to get back on schedule. To address these concerns, HaNS, a novel wireless wrist-worn Haptic Notification System that delivers tactile timing alerts was designed and developed to unintrusively help speakers and session chairs time-manage oral presentations. This thesis describes the iterative design of HaNS and presents the methodology and results of evaluations. The research questions, goals, and contributions are discussed further in the following sections.

1.1 Motivation

Conferences typically depend on session chairs to manage session flow and timing. Session chairs must listen to the talks and prepare their own questions, while time-managing presentation and question-and-answer (Q&A) periods. Their primary tools in this difficult job are a timer and *speaker reminders* (e.g., a "3 minutes" left sign). However, these tools inadequately support what we call the *chair-speaker loop*, in which a chair issues timing reminders (*loop opens*) and receives at minimum the speaker's acknowledgement (e.g., a head nod) to confirm reminder receipt (*loop closes*). First and foremost, the cognitive load experienced by the speakers intrudes on the communication: demands on eyes, ears, and attention easily subvert the *external control* administered by the chair. The speaker's *internal control,* although not of primary focus, is likewise undermined; this is the individual's strategic use of time awareness (gained through tools such as a wristwatch, cellphone, software timer, and/or the session chair's reminders) to actually achieve effective pacing. Finally, the stress created by an audience's possible awareness of this loop can motivate a speaker to conclude the talk quickly, but also reduce his/her ability to do so. A tool that automates coordinated, low cognitive effort session timing and time awareness does not seem to exist.

1.2 Approach and Contributions

To address this void, we iteratively designed and developed a novel wireless wrist-worn chair-speaker Haptic Notification System (HaNS) (Figure 1.1) to deliver tactile timing alerts for time-managing oral presentations. HaNS's deployment on session chairs and speakers was observed through four field observations in three distinct settings: academic research conferences, university research seminar presentations, and university classroom lectures. While university classroom lectures do not include a chair, we included this setting in order to gather preliminary indications of how HaNS might work in that context. The stakeholders for HaNS that were studied in this research are summarized in Table 1.1.

Relative to non-HaNS timing practices, we found that HaNS can with little effort improve a wearer's awareness of the passage of time; it automatically delivers salient notifications, unintrusively, privately and remotely, and it streamlines the chair-speaker loop while minimizing social implications. Unsurprisingly, given the focus on external timing control, speakers using HaNS still went overtime; reducing overruns will require improving a speaker's internal control. Results suggest HaNS may also be a powerful tool for this purpose, given personalization and practice. The intriguing ongoing challenge will be to optimize the apparently conflicting needs of institutional (e.g., conference) and personal use.

The following describes the contributions: HaNS's iterative design and field evaluations which produced subtle insights into stakeholder needs for timing systems, and design recommendations for a new approach to timing support, through touch or other modalities.

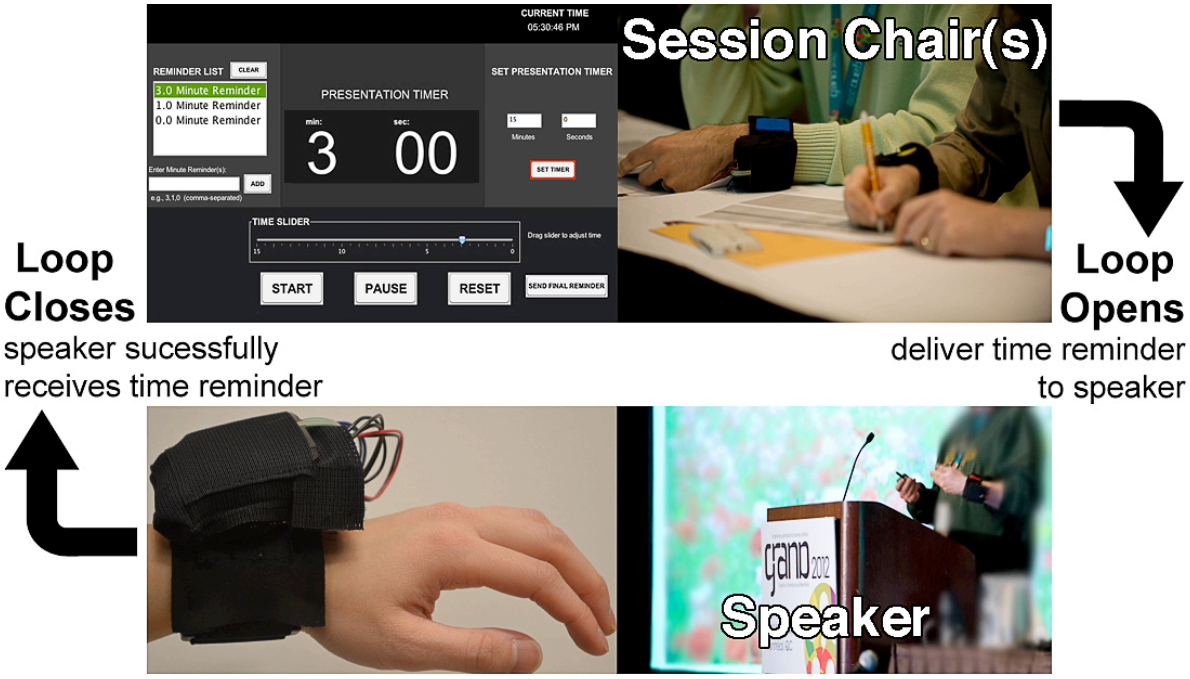


Figure 1.1 Haptic Notification System (HaNS) highlighting the chair-speaker loop. Left to right by row: (*top*) Chair's timing console; co-session chairs wearing HaNS. (*bottom*) Speaker wearing HaNS before; and during a presentation.

Stakeholder (role/responsibilities)	Academic research conference	University research seminar	University classroom lecture
Speaker (delivers a presentation)	researchers (paper authors, keynotes)	researchers (graduate students, faculty members)	instructor
Chair (e.g., monitors a speaker's presentation time, delivers speaker reminders, monitors the Q&A time, and manages overall session flow)	researchers (faculty members, industrial researchers)	researchers (graduate students, faculty members)	N/A
Audience (listens to/watches speaker)	attendees	attendees	students

Table 1.1 The stakeholders studied and their general responsibilities (*rows*) for each presentation setting studied (*columns*).

1.3 Thesis Overview

The thesis is organized into 7 chapters. Chapter 2 (Related Work) discusses research in the area of presentation systems, cognitive theories, and tactile perception that support the arguments presented here in the Introduction. Chapter 3 (Haptic Notification System) describes the hardware, software, and functionality of the prototype system as well as the highly iterative design and evaluation process taken to gather initial design goals for the system. Chapter 4 (System Evaluation) provides extensive coverage of the study approach including the evaluation settings, the study procedures, as well as the participant summary. That chapter also presents the quantitative and qualitative findings of the evaluations, namely, speakers and session chairs' non-HaNS timing practices followed by a full assessment of HaNS. Chapter 5 (Discussion) summarizes the findings and the contributions of this research, and Chapter 6 (Implications for Design) presents design implications for a future timing system. Finally, Chapter 7 (Conclusions and Future Work) provides further insights into how haptics might be explored in future presentation-related studies.

Chapter 2

Related Work

Despite the cognitive demands already imposed on speakers, current commercial and research systems that offer presentation timing support are largely visual in nature. Haptics, on the other hand, operates on a channel that is little used when presenting, making it an efficient modality to utilize according to cognitive theories relating to mental resource management. However, little work on haptic design for presentation use has been done. In this chapter, presentation systems that currently offer timing support are described along with their limitations. Cognitive theories and past research that demonstrate the modality-appropriateness of touch for the presentation setting are also highlighted. Related work on haptic design and wearables is then presented, which form the basis of the wireless wrist-worn Haptic Notification System design.

2.1 Existing Presentation Support: Visually Dominated

Chair-speaker presentation systems. Despite – or because of – its unique challenges, no products or studies appear to support session timing. The essential need is to increase speakers' and session chairs' awareness of time *while* automating the communication loop, which existing timing systems (below, predominantly visual) do not address.

Commercial systems. Products that support speakers in timing their talks have been slowly evolving for decades, with progress heightened in the 10-15 years since laptop-mediated presentations displaced projected transparencies and microprocessors embedded in handheld devices have become commonplace. A timing system can be contained within a presentation itself, offering presets and timers shown visually on a separate screen; Microsoft PowerPoint™ (Microsoft PowerPoint, 2012) may be the most familiar instance. Many presenters and session chairs prefer a separate timing device with a display that can always remain in view, such as the timer functions on digital wristwatches and specialized 'apps' on smartphones – often placed on a podium or table for visibility. Handheld 'presentation remotes' are popular among those who speak regularly, and these might have a small LCD display that can be programmed with a small number of timed alerts that might be delivered visually, e.g., (Logitech, 2012). Some of these systems as well as other commercial devices (Mutewatch, 2012; Robinett, 2002) further support the use of silent tactile alarms such as a phone, watch, or

remote that vibrates. Their overall effectiveness for speakers does not appear to have been thoroughly explored. Furthermore, intended solely as personal devices, they do not address the chair-speaker loop.

Research systems. Despite the fact that a presenter's visual channel is highly overloaded, presentation-related research has relied on visually demanding solutions. For example, systems that have been studied present timing information visually through ambient displays using light, colour, and progress bars that sit in a person's peripheral vision (Mamykina et al., 2001; Occhialini et al., 2011; Spicer & Kelliher, 2009) or visual displays for audience members to hold up when a speaker's time is up, placing pressure on the speaker to stop (Dredge, 2007; Laibowitz & Paradiso, 2004). However, these timing methods are quite public and may further heighten the stress of a speaker. Further, pacing solutions designed to help speakers track progress as well as presentation trainers similar to that of Microsoft PowerPoint's rehearsal mode have also focused on providing visual feedback (Kurihara et al., 2007; Okada et al., 2011; Spicer & Kelliher, 2009; Spicer, Lin, & Kelliher, 2009; Spicer, Lin, Kelliher, & Sundaram, 2009). Other presentation-related studies have not focused on timing specifically, but demonstrate a continuum for visual-based solutions: visual presentation content management methods for managing and navigating content more easily (Good & Bederson, 2002; Lanir et al., 2008) and hand-held presentation control systems that display information visually (Hafernik & Wang, n.d.; Myers, 2000). Missing are time awareness solutions that are non-visual in nature.

2.2 Mental Resource Conflicts: Modality and Attention in Demanding Environments

Cognitive theories. The visual and auditory channels are used during both rehearsal and presentation delivery. Preparing for a talk involves visually processing images and text while verbally rehearsing the delivery of content. While rehearsing, information is visually and acoustically coded (Atkinson & Shiffrin, 1968; Baddeley, 1999; Matlin, 2005; McLeod, 2007) into short-term (working) memory, which uses the central executive part of the prefrontal cortex of the brain controlling both visual (visual cortex) and language (Broca's area) data (Baddeley & Logie, 1999; Fine, 2008; Mastin, 2010), and long term memory through the creation of meaningful associations to be easily remembered while presenting (Ebbinghaus, 1964; Sperling, 1960; Sternberg, 1999; Wickens, 1972). In fact, the dual-coding theory indicates that information is best remembered when it is stored in long-term memory using mental representations created both verbally and visually (Clark & Paivio, 1991; Paivio, 1971; Paivio, 1986). While presenting, the brain will re-visit the nerve pathways formed during the encoding process and recall information by association (Atkinson & Shiffrin, 1969; Baddeley et al., 2009).

Theories of managing mental resources. Decades of modeling mental resources and analyzing multimodal interfaces makes the impact of modality planning on task performance quite clear – it is essential to choose an appropriate modality or combination thereof to convey information to a user (Cao et al., 2008; Oviatt et al., 2004). The cognitive Modality Principle, which states that when giving multimedia explanations, words should be presented as auditory narration rather than as visual on-screen text (Bachvarova et al., 2007; Moreno and Mayer, 1999), stems from theories of human cognitive processing (Baddeley, 1992; Chandler & Sweller, 1991; Paivio, 1986). These theories, including the dual-coding theory (Paivio, 1971) and Wickens' multiple resource

theory (1984), indicate that humans process information more effectively when multiple channels work together in a coordinated manner (rather than processing all information through a single channel) because each channel has a limited capacity. Thus, as visual and audio-based solutions increase sensory load in their respective channels, performance may decrease while speakers miss important information or become highly distracted.

Attention in multitasking use. Human performance degradation is borne out in many studies of how sensory and attentional resources interact and compete in a wide variety of task overload situations involving computation, communication, collaboration, and recovery from disruption – with public speaking being one of the most demanding (Horvitz et al., 2003; Iqbal & Horvitz, 2007; Ouslavirta et al., 2005) – and extending to basic ambient awareness (Dabbish & Kraut, 2008; MacLean, 2009). Further, psychology research indicates that accurate time estimation suffers when individuals are performing a cognitively demanding task (Burle & Bonnet, 1999; Casini & Macar, 1999; Predebon, 1999).

Modality-appropriateness of touch. A solution utilizing touch, a channel that is minimally used when presenting, could deploy the speaker's mental resources more efficiently. Studies have shown that presenting information through haptics reduces the cognitive load on the visual and auditory channels and improves their performance (Jones et al., 2006; Luk et al., 2006; Leung et al., 2007). While automated (pre-set) notifications in any modality could theoretically relieve a user of the need to 'poll' (repeatedly check) timing parameters (e.g., auditory nonverbal clicks through an earbud device, flashing lights on the podium), those delivered through a device worn on the skin do not require a user to look or listen. Thus, touch seems the most viable candidate from a resource standpoint. Although there currently exist some haptic-based solutions or concepts as mentioned above, the modality's use does not appear to have been studied in the presentation context. In particular, these devices deliver generic vibrations that have not been specifically tailored for presentation use where anxiety and stress levels may be high and user interactions with the device should be subtle.

2.3 Tactile Perception of Wearables: Body Locale and Iconography

Body location and form factor. The wrist is one of the most sensitive body locations for vibrotactile stimuli. It particularly stands out during lower-body movement (walking and standing) when lower limb sensitivity drops, and visuo-cognitive distractions (Fiege, 2009; Karuei et al., 2011; Harrison et al., 2009; Lee & Starner, 2010). In addition to being one of the few socially acceptable locations where a device could be worn when presenting in front of an audience, the wrist is also a key site for functional social touch as observed both in human-to-human touching (Jones & Yarbrough, 1985) and as mediated through a haptic device (Baumann et al., 2010; Haans & IJsselsteijn, 2006). Wrist-worn haptic wearables (Bau et al., 2009; Baumann et al., 2010; Bosman et al., 2003; Lee & Starner, 2010; Lindeman et al., 2004; Stanley & Kuchenbecker, 2012; Tsukada & Yasumura, 2004) offer insights as to construction, sensitivity, comfort and, material implications.

Design and delivery of meaningful signals. Past research on haptic icon design, some summarized by MacLean (2008), provides a solid starting point for designing salient yet unintrusive warning and alert tactile mappings. A vibrotactile display is inexpensive and easy to engineer, conferring simplicity and high amplitudes. While it is also limited in expressiveness and tends to become annoying over time, in balance it is a reasonable

choice for brief-duration applications where high intensity stimulation may be needed and a limited variety of distinguishable signals are required.

Signal perception, primarily vibrotactile and usually on the fingertips, has been examined closely in the context of variation of intensity (Brown et al., 2006; Israr et al., 2006), duration (Erp & Spapé, 2008; MacLean & Enriquez, 2003; Pakkanen et al., 2008; Ternes & MacLean, 2008; Qian et al., 2009), and tempo and rhythms (Ternes & Maclean, 2008; van Erp & Spapé, 2003). In many cases, these studies demonstrate that tactile information can be expressively conveyed through patterns (Chan et al., 2005; Heikkinen et al., 2009; Ito, 2009; Swerdfeger et al., 2009). It has also been observed that arbitrary mappings can be learned as easily as those intended to have an intrinsic meaning (Enriquez & MacLean, 2008). Systematic techniques to ensure optimal perceptual spacing between stimuli and perceptibility under stress (Chan et al., 2008; MacLean & Enriquez, 2003; Ternes & MacLean, 2008) are essential for large sets of haptic signals. For smaller sets used in diverse situations, ad hoc creation combined with iterative testing and refinement (Allen et al., 2005; Brown et al., 2005; Brown et al., 2006; Brown & Kaaresoja, 2006; Enriquez et al., 2006; Tang et al., 2005; Visell, 2009) are suitable. This is the approach taken here.

As will be seen in the remaining chapters of this thesis, the design of haptic icons for use by a diverse range of users in a presentation setting brings special challenges of its own. In the next chapter, the details of the Haptic Notification System design are discussed for which this chapter has provided the background rationale.

Chapter 3

Haptic Notification System

The Haptic Notification System (HaNS) has six elements that required independent and then integrated design: wrist-worn haptic devices to be worn by a lineup of speakers and the session chair(s), the haptic signals themselves, a session chair timing console, an experimenter console for overseeing system functions, the wireless communication protocol, and finally, the numerous social protocols surrounding their use. This chapter first describes the iterative approach taken to gather specific design needs and wishes for HaNS, followed by details of the final design.

3.1 Iterative Design and Preliminary Testing

In order to gather requirements for a notification system, even the preliminary user testing and evaluation needed to be done in realistic presentation settings to obtain valid feedback. However, gaining access to actual high-stakes oral presentations during the early development phase seemed unlikely (and overly risky) because of the potential to disrupt a real conference. Consequently, a highly iterative user-centered design and evaluation approach was taken, inviting speakers and session chairs of academic seminar presentations at the University of British Columbia to pilot-test HaNS. Early iterations focused on the speakers to learn how the notifications and acknowledgement gestures should be designed while gathering chairing requirements through observations. Later iterations further refined and tested a fully implemented and automated version of HaNS. In total, pilot tests were conducted during 18 presentations with 7 master's students, 5 doctoral students, and 3 postdocs. Three of the speakers used HaNS for two presentations; their second experience was quite different than their first because the design evolved between each participant. The presentations included academic research seminars, practice conference talks, research paper discussions, and one Master's thesis defense. Also, 2 of our postdoc pilots and 2 additional faculty members helped test HaNS's timing console one or two times each while chairing. Given that these pilot tests were limited to a university seminar-type setting, brief interviews were also conducted with 5 pilot participants who had previously spoken at and/or chaired sessions at conferences to get a broader sense of both the tasks and the stakeholders involved in more formal settings. At the end of the pilot tests, two mock presentation sessions were held with a subset of our pilot participants to understand communication and logistic flow in a conference-like setting with multiple (5 to 7) speakers and a single chair. While wearing the haptic device, speakers gave a three-to-five minute presentation on a topic of

their choice and the session chair configured the timing console. Through these tests complex interaction issues were addressed such as the activation / deactivation and donning / doffing of devices between successive speakers, while performing final evaluations of HaNS.

3.1.1 Haptic Notifications: Understandable and Unintrusive

The notifications were initially triggered manually for pilot tests to learn which notification time points, intensities, durations, and patterns of haptic cues provided the best benefit to speakers based on qualitative feedback before these details were automated in HaNS. In particular, each tested haptic notification was evaluated to see if it was easy to notice and interpret, and whether it startled the speaker, which was deemed to be an undesirable property. Through this process, we found that ramping up the cue over time, lowering the overall intensity of the vibration, and using temporal patterns all helped lessen the startle effect and thus the distraction of haptic alerts while retaining much of their salience.

3.1.2 Session Chair's Timing Console: Display/Trigger Modes and Granularity

Pilot chairs also confirmed the value of receiving the same wristband notifications as the speaker, and the need (and cognitive ability) to access more detailed timing information that is best shown visually such as a clock or timer on a wristwatch, smartphone, or laptop. A console must also support triggering additional (unplanned) notifications or cancel automated ones. Therefore, these capabilities were implemented in HaNS's timing console and tested during the final rounds of pilot presentations. While this was a new interface, it was very secondary to the haptic devices in terms of design effort. The goal was to create something basic and then use it as a source for further requirements gathering of any other chairing-specific needs during the actual study.

3.1.3 Chair-Speaker Loop: Acknowledgement-Free

Our original intent was to improve the reliability of current chair-speaker communication by delivering and confirming reminders and minimizing disruption. However, a significant design-phase insight was that if cues are reliably noticed, then a speaker's 'delivery receipt' might be unnecessary, which subtly changes the loop. While a notification system can automatically open the loop by delivering notifications to the speaker, the major challenge perceived was how to design the system to close the loop in a manner that was not intrusive to the speaker but also easily noticed by the session chair. During early iterations, pilot speakers were asked to perform various gestures to confirm receipt of each notification, including eye contact with the session chair, a head nod, covering parts of the wrist device with their hand or body, and tapping and shaking the device. Speakers found every explicit acknowledgement gesture disruptive and preferred not to perform them, but without exception reported noticing the cues. The speakers were also unsure if they successfully performed a gesture. Thus, perhaps the most unexpected design development was making notification acknowledgment optional, thereby fundamentally altering the chair-speaker interaction by largely removing it and allowing speakers to focus on presenting. The notifications would terminate after an interval, but the speaker was allowed

to stop them earlier by pressing the wristband – this was volunteered as the most natural gesture, and easily detected. Upon acknowledgement, the notification would stop immediately following two quick confirmation pulses (2.9V x 0.1 seconds on, 0.1 seconds off). This solution appeared to be a good compromise between chair reassurance and speaker workload.

3.2 General Notification System Design Goals

Iteratively designing and testing our prototype system provided insights into initial requirements for systems that deliver timing notifications (through touch or any other modality) to speakers and session chairs during oral presentations. The following constitutes the design goals for the final version of HaNS used in the study.

3.2.1 Speaker

Because speakers need to focus as much attention as possible on delivering the presentation, a notification system must provide timing reminders that are informative yet do not negatively impact the speaker's experience. They should have the following attributes:

Salient. Notifications should be easy to notice.

Understandable. Any coding of meaning (e.g., 1st, 2nd or 3rd reminder notifications) must be extremely easy to learn and understand.

Minimal distraction. Notifications must provide minimal cognitive disruption (e.g., minimize startle effect).

Minimal training. Speakers should be able to learn how to use the device with minimal training.

Minimal effort. Speakers should be able to setup and use the system with very little effort.

Automated. Speakers and session chairs should be automatically notified of important timing information without having to manually or repeatedly poll the system.

Flexible. Notification systems should accommodate speakers and session chairs in a wide variety of presentation settings, and accommodate a diversity of body sizes and perceptual sensitivities. The system should be easily configurable (by chair or speaker) as to when notifications are delivered, with reasonable defaults.

Wearable and wireless. A notification system must always be perceptually available to the user; to allow speakers (and chairs) to move freely around the room as they carry out their roles, it generally will need to be worn and untethered to a podium or table.

Robust. Because speakers may rely solely on the notifications, the system needs to be robust and reliable.

Optional notification acknowledgement. The speaker can choose to stop a notification early through a simple acknowledgement gesture. If not acknowledged, the notification should stop on its own.

Provide acknowledgement feedback. Upon acknowledging a notification, feedback should be provided to the speaker to confirm its receipt.

3.2.2 Session Chair

The pilot tests indicated that the chair's cognitive load is far lower than that of a speaker, and s/he is not observed as carefully by the audience. Thus, the design of the notification system should largely be dictated by the speaker's needs with the following additional goals:

Echo speaker experience. The session chair should receive the same notifications as the speaker.

Provide detailed visual backup. Any automated notification system should provide both a countdown timer and a digital clock.

3.3 Description of the Haptic Notification System (HaNS)

The final HaNS design employed two or more wrist devices and a chair timing console. These components communicated wirelessly over a point-to-multipoint network (chair console to wrist devices) using XBee series 2 radios (Digi, 2012). The experimenter monitored system communication flow and device status (e.g., battery levels) through a custom laptop application via another XBee.

3.3.1 System Components

Haptic devices (Figure 3.1). We built 12 velcro-attached wrist displays to accommodate all speakers and session chairs of a session with extras as backups. Each device was uniquely identified within the network and visually by number and colour. A flexible casing was used to house the following electronic components:

- *Arduino Fio microcontroller* (Arduino Fio, 2012): Chosen for its small size, built-in XBee socket, and Lithium Polymer battery connection with a battery charge circuit over USB.
- *An Xbee series 2 radio*: Configured to communicate directly with the master (chair's timing console) XBee.
- *A Lithium Polymer battery (1000mAh)*: 1000mAh was chosen to ensure battery life for long sessions.
- *Three eccentric-rotating mass tactors* (described in (Karuei et al., 2011)) *operated in synchrony:* The tactors were energized with pulse width modulated signals from the Arduino, and situated across the dorsal wrist surface at ~25mm intervals, oriented parallel to the skin surface as in (Israr et al., 2006).
- *Touch sensor*: Notification acknowledgement simulated the gesture of stopping an alarm on a wristwatch. A large (45x45mm) force sensitive resistor at the outside of the device (Figure 3.1) was calibrated to detect light to strong touches (minimum force of ~4.45 N).

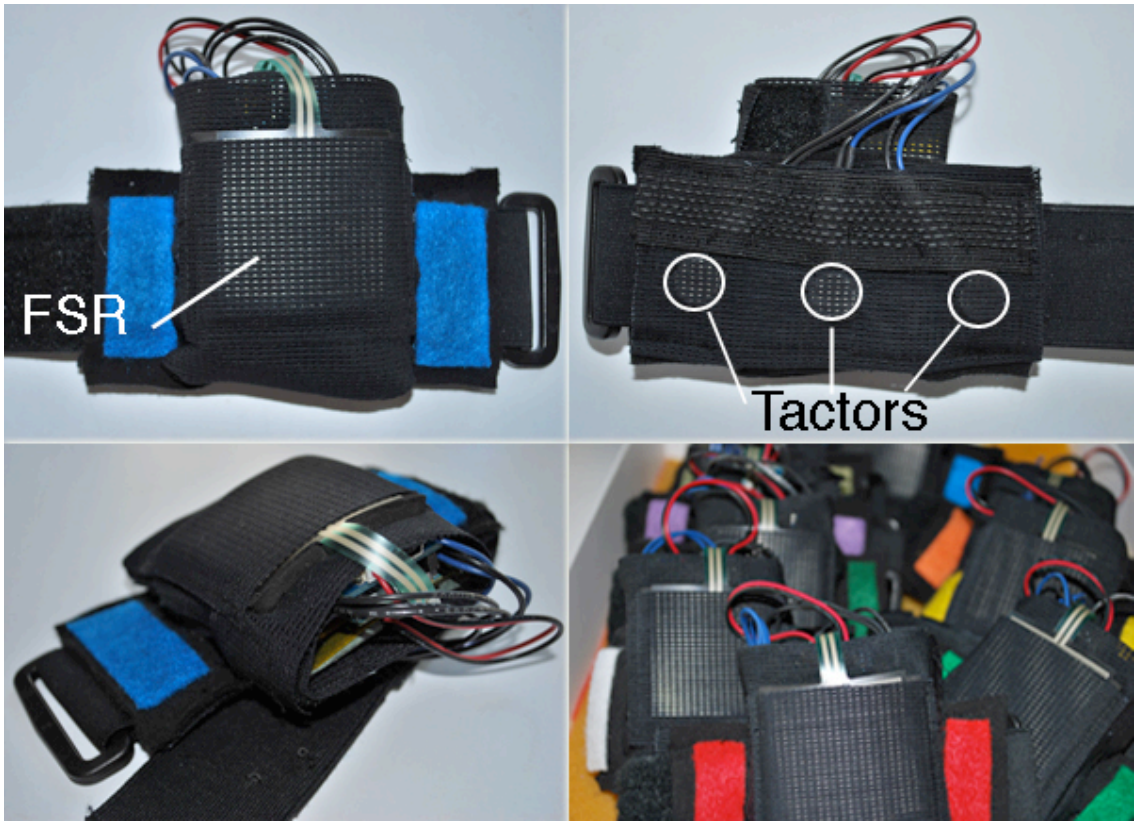


Figure 3.1 The haptic device. ***(top)*** **Left: top view. Right: bottom view showing tactors.** ***(bottom)*** **Left: internal components. Right: group of haptic devices.**

Session chair timing console (Figure 3.2). A laptop Java-based application timed a speaker's presentation, initiated delivery of notifications, and displayed time and events for the chair(s). Its XBee, the network hub, connected to an XBee Explorer USB which enabled the laptop to send serial messages (e.g., "send reminder") to other XBees in the network. Its Java timer application had the following features:

- *Countdown timer:* Display of remaining speaker's time.
- *Current time:* Display of the current time of day.
- *Timer interface:* Buttons to set presentation length, start, stop, pause, resume, and reset; a slider to modify countdown time after the presentation's start.
- *Notification time points setting:* Entry fields for when (time remaining) notifications are to be sent.
- *Notification management:* Automatically broadcasts cues to all haptic devices or to specific devices by ID.
- *Additional overtime notification:* Triggers an extra 'time is up' cue to all devices when speaker is overtime.
- *Device notification acknowledgement on/off:* Controls the user's ability to stop notifications early.

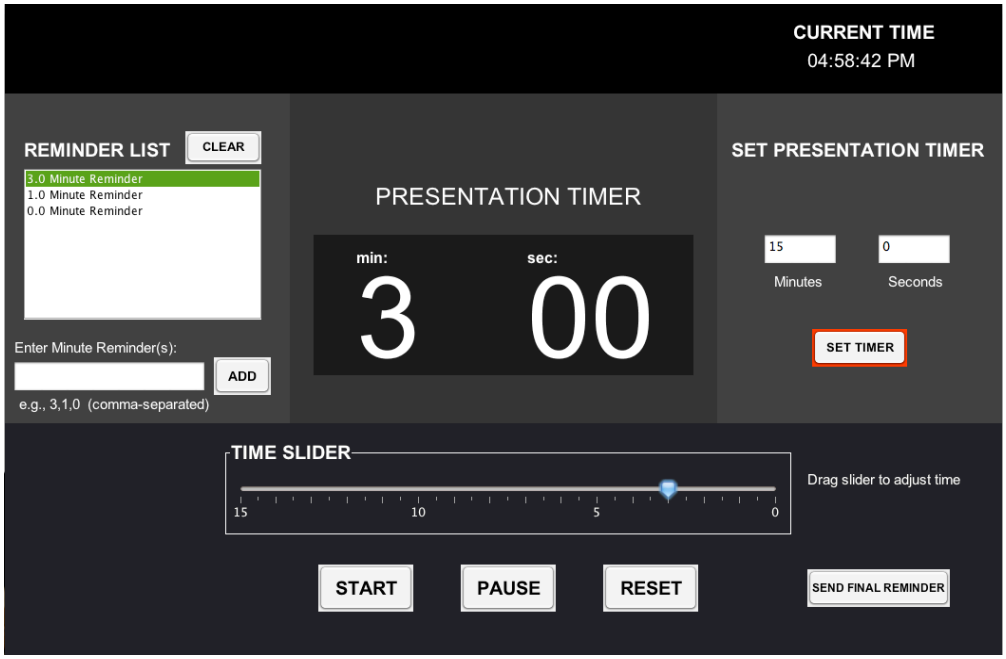


Figure 3.2 Session chair timing console showing timing and notification functions.

Experimenter monitoring console (Figure 3.3). An experimenter monitored the overall system flow to ensure everything on the network functioned as anticipated for the study. A laptop also with an XBee radio and Explorer USB attachment ran a Processing-based (Fry & Reas, 2012) application to do the following:

- *Checking device statuses:* Checks a device's battery level and active status.
- *Configuring device:* Configuring a device if needed (e.g., turn on/off notification acknowledgement).
- *Monitoring XBee communication:* Ensures everything on the network functioned as anticipated.

Figure 3.3 Experimenter console for monitoring HaNS system functions and XBee communication.

3.3.2 Haptic Notification Patterns

Our iterative design process resulted in three vibration patterns (Figure 3.4), designed to be an intuitive mapping between the haptic stimuli and time remaining. The following is a first step towards the development of presentation-specific haptic mappings:

Early warning. Three increasing and decreasing fades over 10 seconds at a maximum amplitude of 1.6V. The duration of each fade was 3.2 seconds with a slight 0.2-second pause in between. This was delivered for notifications set to occur at a specified time point that was greater than 1 minute left in the presentation.

Urgent warning. Ten quick 0.25-second pulses, each separated by a 0.25-second pause, lasting a total of 5 seconds at an amplitude of 2.0V. This pattern applied to any notification set for a time point that was 1 minute or less but greater than 0 minutes left in the presentation.

Time is up. The final 0-minute notification, and any overtime notifications, felt like a flat line at 2.4V lasting 10 seconds.

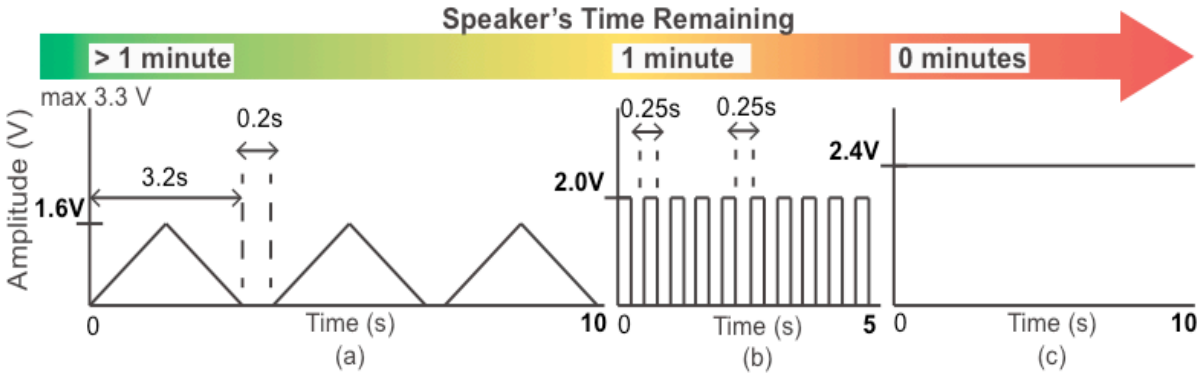


Figure 3.4 Haptic notifications and time points for delivery: a) early warning (T_r (time remaining) >1minute), b) urgent warning (T_r=1m), and c) time is up (T_r=0m). Vibratory frequency (under the voltage envelope) is a function of the tactor's mass acceleration (maximum rotation ~12,000 rpm).

3.3.3 Setup and Chair-Speaker Communication Protocol

Figure 3.5 shows the overall system flow. Prior to the presentation, the chair sets the duration and notification time points on the timing console, and enables notification acknowledgement for the speaker's device so only the speaker can impact cue cutoff. As the presentation begins, the chair starts the countdown timer. At a preset notification point, the chair console highlights (green flash) the respective notification and broadcasts a serial message to all wrist devices (speaker, chair(s) and speaker queue) to trigger the specified vibration (Figure 3.4). At vibration completion, each device automatically confirms delivery to the chair console, which then stops flashing.

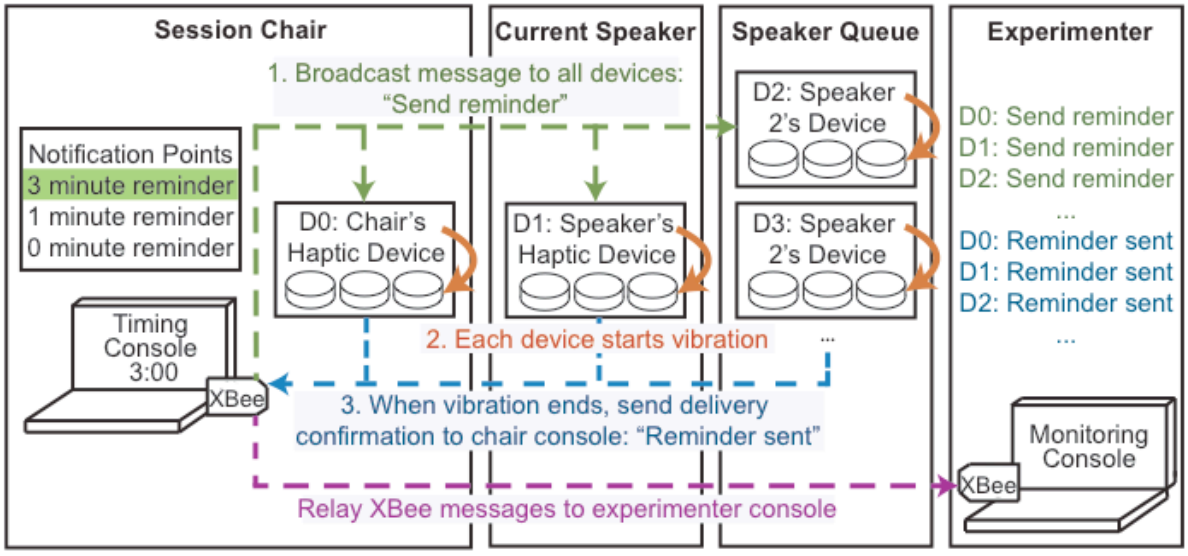


Figure 3.5 HaNS's system components (haptic devices, chair's timing console, experimenter console) and the wireless XBee communication flow (dashed lines) for sending a notification.

Chapter 4

System Evaluation

We conducted field observations in three presentation settings in order to understand current presentation-related timing practices and to learn how the haptic notifications provided by HaNS affect speakers and session chairs. This chapter describes the study procedures, the presentation settings evaluated, and the participants. We also present our findings on current speaker and session chair timing practices, and an overall assessment of HaNS. The study documents (including recruitment emails, consent forms, pre and post-study surveys, and interview questions) for the Haptics Symposium and Class Lecture settings are in the Appendices. The Seminar and GRAND versions of the documents were highly similar to that of Haptics Symposium so are not included.

4.1 Method

HaNS was evaluated in three contexts over a period of three months: academic conference 1) research talks and 2) "madness sessions," 3) university research seminars, and 4) university classroom lectures. This diversity allowed us to study HaNS while varying presentation type, duration, and formality (Figure 4.1). For example, conference talks are highly visible and time-constrained, hence more formal than a small seminar.

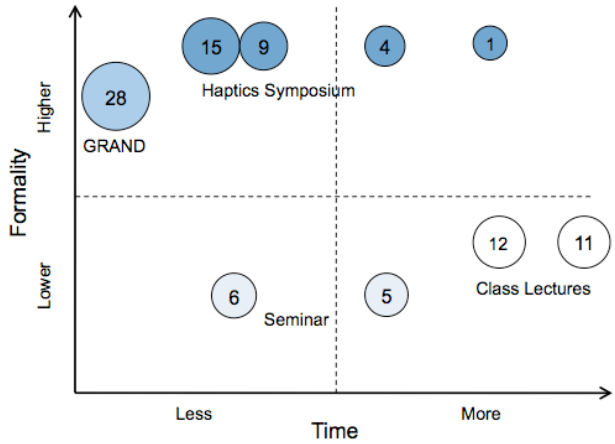


Figure 4.1 A visual distribution of the number of presentations studied across settings according to talk durations (horizontal axis) and level of presentation formality (vertical axis): academic conferences – research talks (Haptics Symposium *N*=29) and madness sessions (GRAND *N*=28), university research seminars (Seminar *N*=11), and university classroom lectures (Class Lectures *N*=23, 3 lecturers).

It was also important to study speakers and session chairs of different experience levels. The need for organizational access led to academic venues in computer science and engineering, related research areas of this work. Upon approving the study, venue organizers provided participant recruitment contacts and assistance with on-site details.

By comparison to the substantial evolution of HaNS throughout the iterative design phases (described in Chapter 3), the design of HaNS stayed largely static in the evaluation described here. It only evolved in the following ways: (1) *haptic devices* – longer wristbands to accommodate speakers with thick suit sleeves, and (2) *session chair's timing console* – timer countdown going past zero to show the amount of time a speaker is over, and enabling the time slider such that the session chair could manage the Q&A period.

4.1.1 Overview of Presentation Settings

The subsections that follow provide an overview of the presentation settings HaNS was evaluated in.

HS (Haptics Symposium): *2012 IEEE Haptics Symposium Conference – paper & keynote talks.* One of the HaNS researchers served as a general chair at the 2012 IEEE Haptics Symposium, providing a unique opportunity to evaluate HaNS at this four-day, ~250-attendee multidisciplinary research conference on touch-interactive systems. The main conference included six sessions of oral presentations of peer-reviewed *papers*; each session was composed of five to seven short (8-minute talk plus 2 minutes for questions) or long (12-minute talk plus 3 minutes for questions) presentations. It also included three oral *keynote* sessions that spanned from 60 to 90 minutes and involved presentations by one, two, or three speakers. There were two session chairs for each of the six paper sessions and for one of the keynote sessions. The remaining two keynote sessions each had only one session chair. All 42 speakers (36 paper session speakers and 6 keynote speakers) and all 16 session chairs were invited to participate in the study.

Notifications. For simplicity, the notification time points for all paper presenters were set to 3, 1, and 0 minutes left in the allotted talk time, regardless of whether they used HaNS or not. Paper signs indicating these three levels of time remaining were printed ahead of time for session chairs to use with non-HaNS speakers. Due to the small number of keynote speakers and their longer presentation lengths (30 to 60 minutes), they were allowed to choose in advance when they wanted to receive the notifications.

GR (GRAND): *2012 GRAND Conference – Graphics, Animation and New Media Forum – two-minute madness (2MM) talks.* GRAND was a three-day research conference on innovation in digital media. This conference serves as the annual general meeting for a large Canadian research network of approximately 65 principal researchers. The director of GRAND invited us to use HaNS during the Two-Minute Madness (2MM) session, a unique presentation venue where speakers give rapid-fire two-minute presentations about the GRAND project they are leading using a variety of methods, mostly talking, but occasionally playing a video, singing, and one person even played a guitar. Timing was very strictly enforced; at the start of the session, all of the speakers lined up in presentation order. Audience interaction was encouraged; a live Twitter feed was

displayed on the projector screen for attendees to tweet to. While GR also included a variety of presentations similar to that of HS, the opportunity to evaluate at the conference came about with very short notice, so HaNS was only evaluated during the 2MM session.

Notifications. The session was chaired by a single session chair who had already determined the notification timing. The chair managed a countdown timer projected on a screen and floor monitors, and when the speaker's time was up, he played loud rock music and cut out the speaker microphone, creating a strong incentive for speakers to stay within their 120-second allotment. Additionally, speakers who used HaNS were given haptic notifications when 60, 30, and 0 seconds remained. Because the session chair was already busy, the experimenter controlled HaNS's timing console, starting and stopping it as the session chair did for the visual countdown timer. Thus, HaNS provided an augmentation to the pre-planned chair-speaker time management at GR, whereas it was primary at HS.

SM (Seminar): *University research seminar presentations.* Within the computer science department at UBC, various research groups hold weekly or monthly meetings where one or two students, faculty, or guest speakers present their work. Four seminar groups were approached whose research foci include haptics, graphics, engineering, machine learning, and human-computer interaction, and upon demoing HaNS, sought approval for evaluating HaNS at their seminar presentations. This diverse set of seminar talks included research presentations where speakers gave informal updates on their work, conference practice talks (more formal and precisely timed to simulate a real conference presentation), and discussion-based brainstorming presentations where the speaker directly involved the audience. Presentations typically followed the traditional format of a talk and short Q&A period. Each session was moderated by a single session chair who set the meeting agenda and scheduled the presentations.

Notifications. Because seminar presentations were informal and easier to coordinate, we allowed speakers to choose when they wanted to receive the haptic notifications (Table 4.1) via responses to the pre-study survey or verbally before the session started. If a speaker or session chair opted not to use HaNS, s/he presented or chaired as usual, using personal timing tools, if any, without the delivery of speaker reminders. The chair typically reminded speakers of the time verbally and gesturally as they neared their session slot's end.

Seminar speaker	Presentation type	Total talk time (minutes)	Notifications (minutes remaining)
A	Guest speaker	30	10, 5, 0
B	Research presentation	25	10, 5, 1, 0
C	Research presentation	25	5, 1, 0
D	Research brainstorming	20	10, 5, 0
E	Research presentation	20	5, 0
F	Research presentation	15	10.5, 3, 1, 0
G	Practice conference talk	15	2, 0
H	Research presentation	10	7.5, 5, 2.5, 1, 0
I	Research presentation	10	7, 3, 1, 0
J	Research presentation	10	5, 3, 1, 0
K	Practice conference talk	8	4, 2, 1, 0

Table 4.1 Seminar speakers: summary of chosen notifications.

CL (Class Lecture): *University undergraduate classroom lectures.* We contacted three UBC computer science professors who we thought would be willing to use HaNS while delivering lectures in undergraduate computer science courses. The lectures were either 50 or 80 minutes long, occurring either two or three times a week: lecturers 1 and 2 each taught twice a week (80 minute classes), and lecturer 3 taught two back-to-back 50 minute lectures three times a week (Table 4.2). This opportunity allowed lecturers' use of haptic notifications to be studied across multiple classes using an AB or ABAB case study approach (AB Design, 2000; Kazdin, 1982), depending on the lecturers' availability and appropriateness of the class schedule. The lecturer used HaNS while teaching approximately two-thirds of the classes observed in the study and did not use it while teaching the rest.

Lecturer	Course description (lecture duration)	# of times taught this class before	# of other university courses taught before	Lecture method	Study approach	# of classes with HaNS	# of classes w/o HaNS
1	computation and programming (80 minutes)	6-10	6-10	live programming, overhead projector slides	AB	4	1
2	object-oriented programming (80 minutes)	6-10	11+	computer-generated slides, clicker exercises	AB	4	2
3	computational models (50 minutes) computer hardware and operating systems (50 minute)	6-10 1-2	11+	computer-generated slides	ABAB (4 classes with HaNS, 2 w/o, repeated)	8	4

Table 4.2 Class Lecture: participant background and study approach.

Notifications. Lecturers were allowed to completely personalize when they wanted to be notified each time they used HaNS (their notification time points). Table 4.3 gives a summary of each lecturer's use of notifications. Namely, lecturer 1 wanted notifications for timing sections of the lecture and for gauging overall class time, lecturer 2 mainly wanted progress notifications to tell him when he was behind, and lecturer 3 typically used a very simple notification scheme to give him an idea of how much class time remained. Because there was no session chair in this setting and the notifications were highly customized, the experimenter delivered the notifications according to the lecturers' preferences.

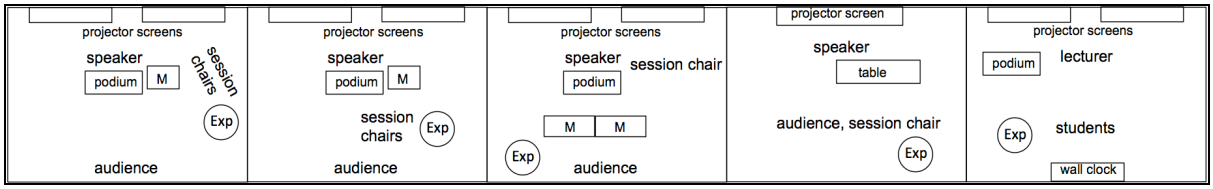
Notifications fell into three categories: 1) sessional, 2) sectional, and 3) progress-based timing notifications. *Sessional notifications* tell the speaker how much time remains in the entire lecture. *Sectional notifications* indicate how much time remains in specific predefined sections of a lecture. For example, a lecturer may want to spend 20 minutes on the first section and 15 minutes on the next. Within each section, the lecturer may want to be aware of the halfway point and when time is up. If the lecturer finishes a section early, no notification is given, and the extra time is allocated to the next section. *Progress notifications* tell the lecturer to speed up if s/he aims to cover a specific amount of material but is falling behind. Progress is determined by taking the amount of content left to teach, for example, the number of lecture slides remaining, and calculating how much

time is available. If the lecturer knows s/he wants to spend a minimum of X minutes on each topic, or slide, then this calculation will determine whether that will be possible, given the amount of class time remaining.

Class #	HaNS used?	Lecturer 1	Lecturer 2	Lecturer 3
		Sessional and sectional notifications	*Sessional and progress notifications*	*Sessional and sectional notifications*
1	Y	sectional – notifications sent when 0 minutes left	sectional – notifications sent when 1 minute overtime	sessional – notifications sent when 30 and 5 minutes left in the class
2	Y	sectional – notifications sent when 0 minutes left sessional – notifications sent when 15 and 10 minutes left in the class	progress – lecturer has a target slide to reach by end of class and wants to spend a minimum of 3 minutes per slide; notification is delivered whenever pace is too slow	(same as above)
3	Y	sectional – notifications sent when halfway and 5 minutes (for long sections) or 2 minutes (for short sections) left	progress – (same as above) sessional – notifications sent when 20 and 5 minutes left in the class	sectional – notification sent when 1 minute left sessional – notifications sent when 30 and 5 minutes left in the class
4	Y	sectional – notifications sent every 10 minutes	(same as above)	sessional – notifications sent when 30, 5, and 0 minutes left in the class
5	N	no notifications	no notifications	no notifications
6	N		no notifications	no notifications
7	Y			sessional – notifications sent when 30, 5, and 0 minutes left in the class
8	Y			(same as above)
9	Y			(same as above)
10	Y			(same as above)
11	N			no notifications
12	N			no notifications

Table 4.3 Class Lecture: summary of chosen HaNS notifications.

Room layouts. Figure 4.2 shows the room layouts for all of the above presentation settings, highlighting the location of the speakers, session chairs (if applicable), audience members, and the experimenter.



(a) (b) (c) (d) (e)

Figure 4.2 Room layouts (not to scale): (a) HS on day one, (b) HS on remaining days (chairing table relocated), (c) GR, (d) SM, and (e) CL. Projector screens displayed the speaker's presentation to the audience, and monitors (M) displayed the presentation to the speaker. The experimenter (Exp) typically sat near the session chairs to answer any study-related questions that arose during the session.

4.1.2 Procedure

A challenge of running a study during live presentations is that often the experimenters cannot meet most of the participants until moments before the presentation session starts, at which time the speakers and session chairs are typically very preoccupied with preparations. One is thus limited in the amount of time available for discussing study details and consent options. The amount of time spent explaining study details also varies across participants. Some subjects may sign-up well in advance, while others at the last minute. The following describes the study procedures along with the special measures we took to address these challenges.

4.1.2.1 Recruitment

The participant pool included faculty, academic researchers (including students and postdocs), and industry researchers, all of whom might understandably hesitate to try something new and potentially disruptive that might increase their already high workload. To encourage participation and familiarization, recruitment emails containing the full study details were personalized and individually sent to each speaker and session chair well in advance of the targeted presentation. Conference speakers and session chairs were invited at least one week prior to the conference, and seminar participants were invited a few days prior to the seminar session. Lecturers were invited about two weeks to a month in advance to ensure their class schedule could accommodate multiple study sessions.

4.1.2.2 Study components

To maximize participation, subjects were allowed to take part in any number of the study components, rather than requiring participation in all components. For example, a speaker could complete the pre- and post-study surveys but opt not to use HaNS during their talk. The study components were as follows:

1. *Pre-study online survey:* Completing a questionnaire that gathered background information relevant to the presentation setting, such as past presentation or chairing experiences and timing practices. Speakers and session chairs completed surveys tailored to their roles and setting. Respondents also indicated here the study components in which they provisionally planned to participate. (Insufficient time for GR speakers to do pre-survey). Signed consent took place at the actual session.
2. *Haptic notifications:* Use or not use HaNS while presenting or chairing. Speakers who did not use HaNS could still participate in the study by receiving reminders in the format standard for that setting, such as a paper sign. Similarly, participating session chairs who did not use HaNS simply used their typical chairing timing tools.
3. *Observation (with or without video recording):* Being observed while presenting or chairing (independent of whether the subject used HaNS). *For GR only*: the cumbersome process of obtaining consent for video recording was avoided by discarding this option entirely and instead, requesting participants' permission to be directly observed though manual notation by three research assistants.
4. *Post-study online survey:* Completing a questionnaire about the participant's experience during the oral presentation or the session chaired. (For GR, the survey included only a subset of the questions.)

5. *Post-study interview (CL setting only):* A brief interview after completion of all lecture sessions to better understand the lecturer's longitudinal experience with haptic timing reminders.

4.1.2.3 Demo and consent signing

Speakers and session chairs were given the opportunity to test HaNS and obtain any necessary clarification from an experimenter or a study assistant before fully consenting to participate in the study. A conference demo booth was set up at both HS and GR for this purpose; at HS, the demo booth was available during all scheduled demo sessions and between all oral presentation sessions, and at GR it was open during the opening reception, the night before the 2MM session. For the SM and CL settings, the experimenter scheduled a demonstration session with each participant before the presentation session or first lecture session.

To expedite the consent process, the recruitment emails also provided a link to a pre-study survey that asked participants to indicate in advance the study components to which they planned to consent. These consent options were then saved, and a customized consent form was printed for participants to sign before their scheduled presentation. Participants were encouraged to complete the pre-study survey (if applicable), try HaNS out, and complete the consent signing well before their scheduled presentation. However, some participants agreed to participate only at the start of their scheduled session. Some GR speakers (9 out of 30) even joined the study while lining up for their talks. To accommodate these participants, the pre-study survey could be completed immediately after the session because its questions focus on the subject's background and past experiences, which do not relate to the post-study survey. The last-minute consent process was also facilitated by making sure HaNS was intuitive and quick to learn, and by having the study details and consent forms emailed well in advance and ready to be signed.

4.1.2.4 Session flow

Before each presentation session started, HaNS's timing console was set up on the chairing table by the experimenter (HS and SM settings only), and all participants who agreed to use HaNS in that session were given a haptic device to wear on the wrist of their choice. This preparation not only prevented disruptions while the session was in progress, but it also provided speakers scheduled to talk later in the session with additional opportunities to feel and become familiar and comfortable with the haptic notifications while the earlier speakers presented. The GR setting was the only session where the combined number of speakers, the session chair, and the 3 research assistants (observers), all of whom required a haptic device, exceeded the number of devices available (12 in total). As each participating speaker came off the stage, their haptic device was handed to the next speaker in the queue who needed one. There were 8 haptic devices available for the 2MM speakers, which meant some speakers were able to feel the notifications while 6 or 7 speakers ahead of them presented. One speaker said, *"It was actually useful to wear it while others presented to familiarize myself with the cues and what each meant."*

At the end of each session, the haptic devices were returned to the experimenter, and each participant received an envelope containing a thank-you letter with a link to the post-study survey. Compensation, if given (described below), was also included in the envelope.

4.1.3 Participant Summary

The following describes the participation level from each presentation setting evaluated, as well as the background and experience of the participants.

4.1.3.1 Participation level

Table 4.4 shows the number of participants who consented in each evaluation setting, including the total number of speakers and session chairs who used HaNS or did not use HaNS, along with the participation count for each study component. It also shows the number of HS and SM *audience* members who participated in a brief questionnaire about their overall impressions of presentation timing at the sessions they attended. There was some overlap among HaNS users; 7 (4 SM, 3 HS) speakers had been pilots, 2 (1 HS, 1 GR) presented twice, and 3 (HS) speakers also participated as chairs. However, HaNS had evolved significantly since early piloting, and presentation type, length, venue, audience, and/or role varied, so the experience remained quite novel even for these users.

Setting	Participant	Pool Size	HaNS?	Total # Participated	Pre-study	Observation	Post-study
Haptics Symposium (HS)	Speaker (HS_{spk})	42	**h** / *nh*	22 (1 female) / *6*	21 / *6*	19 / *3*	21 / *4*
	Session chair (HS_{chair})	16	**h**	15 (6 female)	15	11	14
	Audience (HS_{aud})	250	—	50	—	—	50
GRAND (GR)	Speaker (GR_{spk})	30	**h** / *nh*	24 (10 female) / *3 (2)*	—	24 / *2*	22 / *2*
	Session chair (GR_{chair})	1	**h**	1	1	1	1
Seminar (SM)	Speaker (SM_{spk})	11	**h**	11 (2 female)	11	11	11
	Session chair (SM_{chair})	5	**h**	5	5	5	5
	Audience (SM_{aud})	~50 unique	—	15	—	—	15
Class Lecture (CL)	Professor (CL_{prof})	3	**h**	3	3	3	23
TOTAL	Speaker	86	**h** / *nh*	60 / *9*	35 / *6*	57 / *5*	77 / *6*
	Session chair	22	**h**	21	21	17	20
	Audience	~300	—	65	—	—	65
				155	**62**	**79**	**168**

Table 4.4 Participation counts for each study component, using (h) or not using (*nh*) HaNS, across settings. Note: 1 HS and 1 GR HaNS speaker presented twice.

HS and SM participants each received $10 compensation, and CL participants received $20. Due to the brevity of the experiment, GR participants were not given any monetary compensation, but they received an extra reception drink ticket if they signed up during the conference opening reception.

4.1.3.2 Status, experience, and background

The pre-study survey asked participants about their past presentation and chairing experiences, particularly in settings in which ending on time was important. Figures 4.3 and 4.4 give a breakdown of the status and past experiences collected for the HS and SM settings. Not surprisingly, junior participants (master's and doctoral students) typically had less presentation experience than more senior individuals (postdoc, faculty, and industry researchers) in the same setting, and all the session chairs were of senior status with the majority being very experienced at chairing. There were 6 HS speakers and 2 HS chairs without conference experience. However, 4 of the speakers and 1 of the chairs had presented or chaired in a setting with similar timing constraints. Background information for the 3 CL participants can be found back in Table 4.2 (Section 4.1.1), showing a diversity of teaching approaches. GR participants did not complete a pre-study survey, but observations showed that all were faculty members.

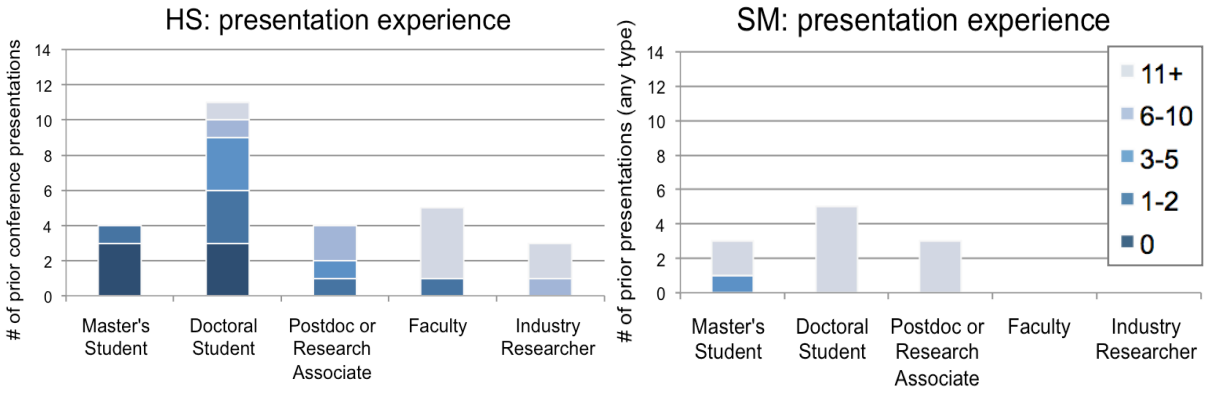


Figure 4.3 Left: HS speakers – number of prior conference presentations (N = 27). Right: SM speakers – number of prior presentations of any type (N = 11).

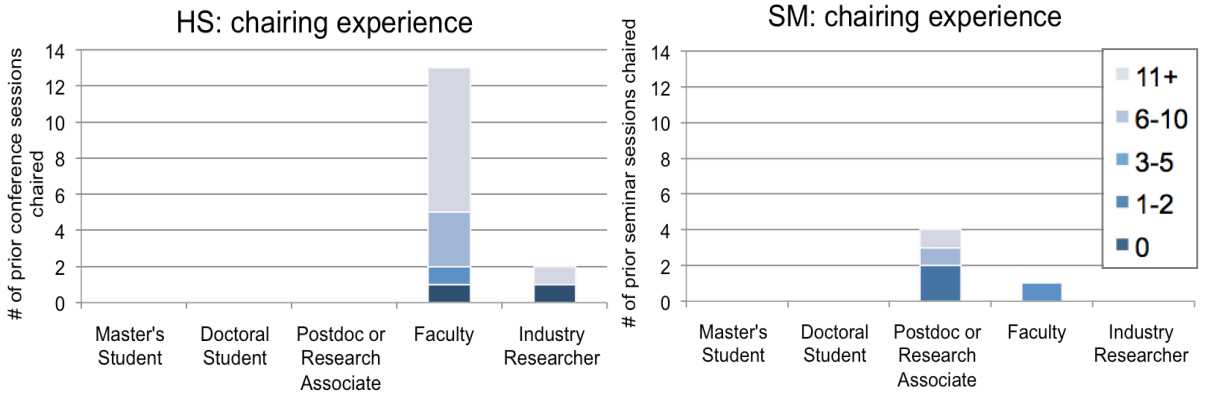


Figure 4.4 Left: HS session chairs – number of conference sessions chaired (N = 15). Right: SM session chairs – number of seminar sessions chaired (N = 5).

4.2 Results

Data was collected from 62 pre-study surveys, 40 hours of video and 27 direct observations of speakers and session chairs during the presentations, 168 post-study surveys, and 2 post-study interviews with CL participants. Quantitative data was analyzed descriptively and qualitative data using a top-down content analysis open coding approach (Corbin & Strauss, 2008; Lazar et al., 2010). Having multiple data sources allowed for data source triangulation (Stake, 1995). In total, 81 participants used HaNS. Of the participants who used HaNS and completed the post-study survey, 12% [9/77] were left-handed (3 wore the haptic device on the left wrist, 6 wore on right wrist), 87% [67/77] were right-handed (41 wore on left wrist, 26 wore on right wrist), and 1% [1/77] was ambidextrous and wore the haptic device on the left wrist. Also, of those participants observed, 15 wore a wristwatch, and 9 of these subjects wore the haptic device on the same wrist as their watch. Thus, neither hand dominance nor watch wearing were strong predictors of where the haptic device was worn.

In the following, we report speaker and session chair practices collected from pre-surveys (Sections 4.2.1 and 4.2.2 respectively), both general aspects of timing approaches and preparation styles, and specific non-HaNS timing practices. The results delivered few surprises, but are summarized here for completeness. In the remaining sections, we present observed and post-survey reported utilization of and reactions to HaNS as: a) impact on overall presentation time, b) feasibility as a conference timing system, and emergent c) improvements and d) limitations.

For conciseness of reporting, the format (w% [w_1/w_2], x% [x_1/x_2], y% [y_1/y_2], z% [z_1/z_2]) to denote (w% [w_1/w_2] **HS**, x% [x_1/x_2] **SM**, y% [y_1/y_2] **GR**, z% [z_1/z_2] **CL**) will now be used.

4.2.1 Speaker Reminders

Most speakers reported having past experiences with speaker reminders (76% [19/25], 91% [10/11], —, —), particularly the *visual sign* (79% [15/19], 100% [10/10], —, —). The majority of session chairs also preferred *holding up a visual sign* (71% [10/14], 40% [2/5], —, —). Other types of speaker reminders included a session chair giving hand signals, verbal reminders, standing up, or ringing a bell. Although 76% [22/29] of all HS and SM speakers found reported speaker reminders easy to understand, 45% [13/29] found them hard to notice, 62% [18/29] did not like how they were noticeable by the audience, and 28% [8/29] thought they were distracting. Furthermore, session chairs reported feeling uncomfortable with being responsible for interrupting the speakers (57% [8/14], 80% [4/5], —, —) and with being noticed by the audience when delivering speaker reminders (64% [9/14], 60% [3/5], —, —). Five HS session chairs explicitly commented on how they wished that timing was automatically communicated to the speaker.

4.2.2 Personal Timing Tools

The majority of speakers reported that they typically use a personal timing tool while presenting (52% [13/25], 73% [8/11], —, 100% [3/3]). The preferred timing tools included: *the stopwatch or timer feature on a cellphone or smartphone* (38% [5/13], 50% [4/8], —, 0% [0/3]); *a wristwatch* (23% [3/13], 13% [1/8], —, 33% [1/3]); *a presentation software timer* (23% [3/13], 38% [3/8], —, 0% [0/3]); and *a wall clock* (15% [2/13], 0% [0/8], —, 67% [2/3]). However, despite the fact that 92% [22/24] of these speakers found their timing tools simple to use, 42% [10/24] also found the timing information easy to miss and 63% [15/24] disliked the need to continually poll for the time in order to gauge progress. $HS_{spk}18$ reported forgetting to look at his cellphone while presenting, but used it because it was all he had.

Of the speakers who do not use timing tools while presenting (48% [12/25], 27% [3/11], —, 0% [0/3]), all reported timing their presentation during practice, a much higher percentage than for speakers who typically use timing tools while they present. Other reasons participants gave for not using timing tools during presentations tended to center on negative emotional or cognitive side-effects such as nervousness or distraction. But of those who did not use a timing tool, 17% [2/12] HS and all [3/3] SM speakers actually reported having a timing tool but forgetting to use it. $HS_{spk}15$ even declared, *"I am training myself to keep track of time."*

Not surprisingly, all of the HS and SM session chairs reported using a timing tool when chairing. Their chosen timing tools included: *the clock or timer feature on a cellphone or smartphone* (79% [11/14], 40% [2/5], —, —); *a wristwatch* (21% [3/14], 20% [1/5], —, —); and *a computer clock* (0% [0/14], 40% [2/5], —, —). Similar to speakers, session chairs generally found the timing tools easy to use and understand, but felt it effortful to continually poll for the time. However, 3 HS session chairs (2 used cellphones, 1 used a wristwatch) commented that their timing tool was always available to them, which is why they continued to use it despite the limitations. As will be shown, improved noticeability, automation, privacy, and low distraction all factored into the perceived benefits of HaNS.

4.2.3 HaNS — Impact on Presentation Outcome

HaNS users can go overtime. For each HS and SM speaker, the presentation end time (how much a speaker finished over or under his/her allotted talk times) was calculated among speakers who used and did not use HaNS (Figure 4.5(a)). GR and CL participants were excluded from this comparison; going overtime was not permitted for the GR 2MM speakers (the microphone would cut out) and CL participants occasionally had important announcements for the students at the end of class or needed a few extra minutes to finish covering important class material. In total, approximately half of the HaNS speakers went overtime (43% [10/23], 55% [6/11], —, —) with a close proportion of non-HaNS speakers going over (45% [9/20], —, —, —). The average number of seconds that HaNS speakers went over was 51 (HS) and 77 (SM), which was slightly higher than the 32 seconds (HS) for the non-HaNS speakers. Thus, HaNS did not seem to prevent speakers from going overtime.

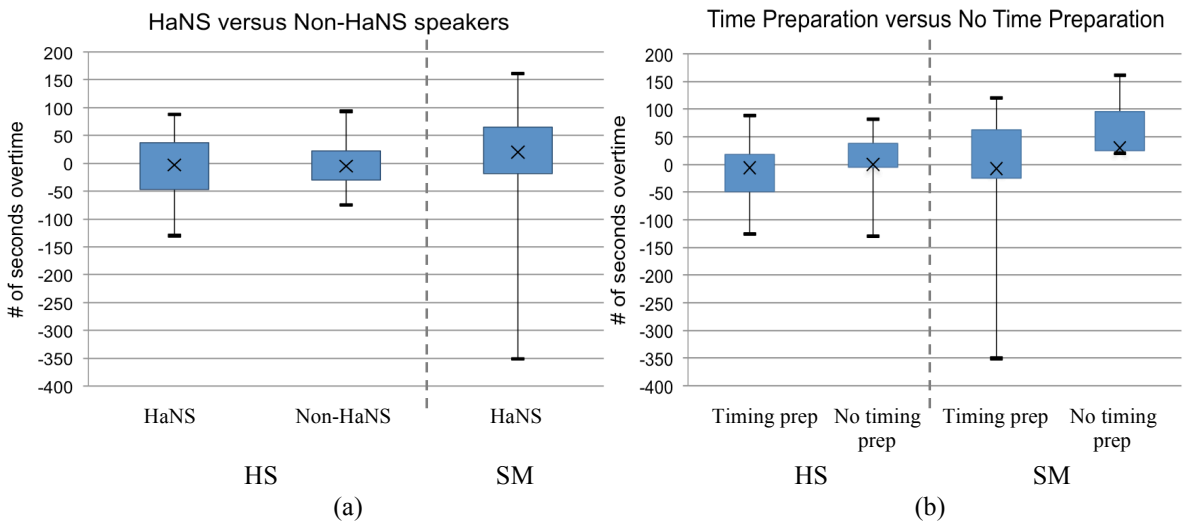


Figure 4.5 Presentation end time: a) speakers using HaNS (HS – *N*=23, SM – *N*=11) versus not using (HS – *N*=20), b) speakers with timing preparation (HS – *N*=20, SM – *N*=8) versus no timing preparation (HS – *N*=5, SM – *N*=3).

Speakers who time themselves during practice can go overtime. The presentation end times of speakers who reported timing their presentation during practice in the post-survey were compared with those who did not, regardless of whether HaNS was used (Figure 4.5(b)). Again, GR and CL participants were left out of this comparison; GR speakers were not allowed to go overtime and CL participants typically did not engage in timing preparation. In both HS and SM settings, speakers who time-prepared still went overtime in their actual presentation (33% [7/21], 38% [3/8], —, —). By comparison, the numbers seem somewhat higher for speakers who did not time-prepare and went overtime (40% [2/5], 100% [3/3], —, —), but a more controlled study would be required to validate this.

Emerging here is a distinction between time awareness and strategic use of that information. Whether or not HaNS was used, speakers appeared to go overtime for one or more of the following reasons: they were a keynote or guest presenter, they had technical difficulties cutting into their presentation time, audience members asked questions during the presentation, they were wrapping up their talk, or the session chair started the timer early. Presentation experience did not seem to be a reliable measure for running late because both faculty and industry speakers were among those who went overtime.

Among the overtime HaNS speakers, 4 (3 HS, 1 SM) were keynote or guest speakers who were allowed to go overtime as they were especially invited to present and it is important for them to finish their talks. One of these keynote speakers, along with 2 (HS) HaNS speakers had technical difficulties while presenting that cut into their presentation time. One SM speaker was also interrupted with questions from the audience while presenting. None of the non-HaNS speakers went overtime for these reasons.

Of the remainder (HaNS and non-HaNS), some speakers quickly concluded their talks upon receiving the final 0-minute notification, going over by only a few seconds, while others, even when fully aware of the time,

continued to talk overtime. For example, the 2 HS speakers (1 HaNS, 1 non-HaNS) who went overtime the most tried to get through everything in their presentation despite their time being up. Similarly, upon receiving his final 0-minute haptic notification, $SM_{spk}9$ said, *"I'm just about out of time [looks at device] but I'm almost at the end,"* and then proceeded to talk for 2 minutes and 41 seconds. Most pre-survey speakers (88% [22/25], 91% [10/11], —, —) felt it was important to finish their material and awareness alone may not alter their response when out of time: *"People who went over their time despite the haptic reminders probably chose to ignore it and would have gone over their time no matter what"* [$HS_{aud}36$]. GR speakers even epitomized this commitment, battling on against blaring music with no microphone. $HS_{chair}3$ commented, *"It didn't work for some speakers. He kept talking even after the haptic reminder was activated."* However, all the speakers who used HaNS in the session he chaired showed evidence of noticing the notifications, either in the post-survey or observations, so the issue was not that they did not received the reminders.

Session chairs also often started the timer a few seconds before the speaker started talking, another reason why speakers may have gone overtime as their allotted talk time was cut short.

Taking these reasons into consideration, the presentation end times of all HS and SM speakers were further analyzed by filtering out those who gave keynote or guest lecture presentations, had technical problems that evidently caused them to go overtime, were asked questions while presenting, or only went over by about 5 seconds or less as they wrapped up their talk (Figure 4.6). While applying this filter resulted in fewer overtime HaNS speakers, this demonstrates that speakers can still go overtime despite successfully receiving notifications.

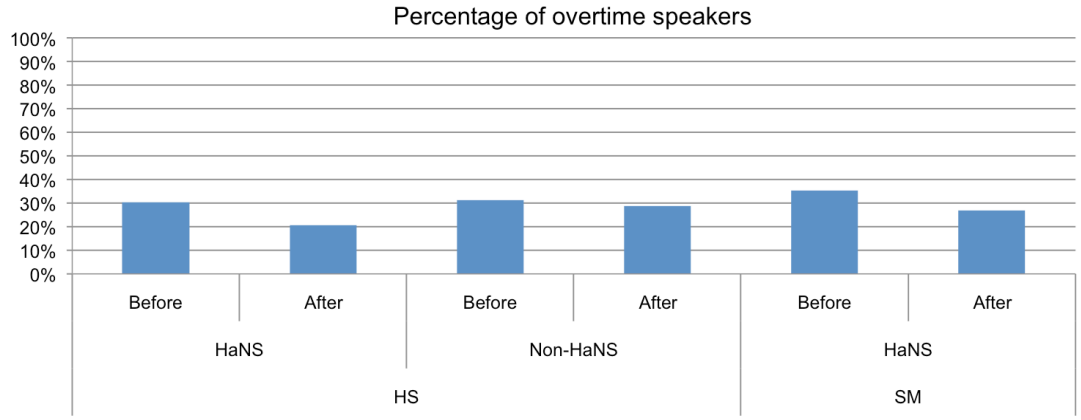


Figure 4.6 Percentage of speakers who went overtime, before and after filtering out speakers who gave keynote or guest presentations, had technical difficulties, were asked questions while presenting, or only went over by 5 seconds or less (HaNS: HS – *N*=23, SM – *N*=11; Non-HaNS: HS – *N*=20).

4.2.4 HaNS — Feasibility as a Chair-Speaker Timing System

We analyzed post-survey responses and observations for HaNS's impact on parameters highlighted earlier (from pre-surveys and further validated in observations) as crucial yet lacking in existing timing systems. Recall that the GR post-survey did not include the full set of questions and the CL setting did not have a session chair.

HaNS notifications were salient. A large percentage of speakers (90% [19/21], 73% [8/11], 68% [15/22], 100% [3/3]) and all the chairs reported HaNS's notifications easy to notice. Although GR speakers responded less favourably, among those who did not find the notifications easy to notice, 1 speaker had technical difficulties with her slides, 1 played a guitar, and 1 sang in a choir during their 2MM presentation, all activities with cognitive, physical, or sensory load above what a speaker usually experiences.

Almost all of the session chairs thought HaNS's notifications were easy for speakers to notice as well (93% [13/14]], 100% [5/5], —, —). For instance, several speakers' behaviour did seem to change after a haptic cue: they talked faster, skipped slides, or mentioned timing, e.g., *"I noticed I'm a bit fast"* [$HS_{spk}14$], *"to wrap things up here"* [$HS_{spk}18$], and *"I'm going to have to move through this quickly"* [$HS_{spk}19$]. Chair comments included, *"The [haptic] reminders definitely get the speaker's attention. [The speakers] are so focused – they do not see the [paper] signs"* [$HS_{chair}1$] and *"I was confident that the speakers noticed [the haptic reminders] right away"* [$HS_{chair}15$]. In fact, very few session chairs felt acknowledgement was still necessary when using HaNS (29% [4/14], 40% [2/5], —, —), while with paper sign reminders, all [11/11] HS session chairs who used signs during the study reported wanting acknowledgement when using these types of speaker reminders.

Automation (and thus precision) improved. HaNS delivered salient cues promptly and consistently, and was thus very accurate. The chairs liked how HaNS automatically notified them of the time without effort to poll (93% [13/14], 100% [5/5], 100% [1/1], —) and relieved them of delivering reminders (71% [10/14], 100% [5/5], —, —). Positive comments included, *"I didn't have to keep looking at the clock to keep track of time"* [$HS_{chair}6$] and *"I did not have to signal [the time] to speakers during presentations. I could concentrate on the talks better"* [$HS_{chair}12$]. HS and SM speakers also liked the automation, but GR speakers and $CL_{prof}1$ were less enthused (71% [15/21], 64% [7/11], 55% [12/22], 67% [2/3]).

These results are in sharp contrast to those for visual sign notifications (the speaker reminder most pre-survey participants reported experiencing and the form used at HS for the 20 non-HaNS speakers) as observations at HS confirmed. Figure 4.7(a) shows the amount of time it took the session chair to hold up the sign. On average, 4 seconds passed from the moment the sign was supposed to be lifted until it was held up, with the longest delay being 12 seconds. Some session chairs would take a few seconds to realize they had to hold up the sign or take their time to reach over and pick up the sign. Figure 4.7(b) also shows how long the sign was held up across all days of the HS conference. While the sign was usually noticed more quickly when the session chairs sat in front of the speaker, the direction the speaker was looking and how the sign was held caused some speakers to miss the initial delivery of the sign. For instance, sometimes the sign was held high or waved around, and at other times, it was slightly lifted from the table. Session chairs typically displayed the sign and gradually raised it higher and higher until they thought the speaker noticed it. There was even one instance where the second session chair tried to get the speaker's attention by pointing at the sign that the first session chair had been holding aloft for about 25 seconds. Thus, even though the sign indicated 3 minutes remaining, the speaker had no way of knowing that 25 seconds had already gone by. These observations confirm the challenges about use of signs as reported in the pre-surveys.

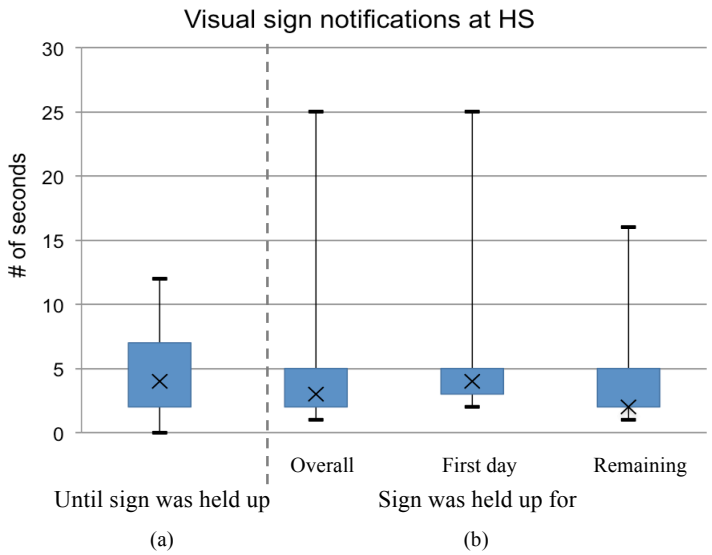


Figure 4.7 Visual signs at HS. The amount of time that passed: (a) before the sign was held up and (b) duration the sign was held before the speaker noticed it, separated by day due to room rearrangement.

Notification delivery was private. One of the main issues with current speaker reminders is that they are noticeable by the audience. HS observations provided confirmation; several audience members were seen looking back and forth between the session chair and the speaker until the speaker finally noticed the paper sign. The majority of audience members also reported noticing when the paper signs were being delivered to the speakers (76% [38/50], —, —, —). By comparison, while a large percentage of these same audience members noticed the haptic device being used by speakers (70% [35/50], —, —, —), largely due to the visible size of the device, very few actually noticed when the haptic notifications were being delivered (14% [7/50], 27% [4/15], —, —). Audience members only noticed the haptic notifications when speakers explicitly commented about them such as *"I'm getting buzzed,"* often in a comical sense due to the novelty of the device. A few speakers also acknowledged the notifications by touching the device, and some did so rather obviously. For instance, 2 HS speakers made the theatrical gesture of slapping the device, which was very visible to the audience. Other than explicit comments or gestures, there were no visible signs of speakers losing their train of thought, being startled, or awkward speech breaks due to the haptic notifications. Some speakers gave subtle cues that they had received a notification, such as a change in pace, skipping slides, or making comments such as *"sorry I don't have the time to explain this."* These were all implicit indications that the speaker successfully received the notifications and was aware of the time.

Audience members also appreciated the private reminders: *"I think [the haptic notifications] are really beneficial, because for the most part they go unnoticed to the general audience"* [HS_{aud}43], *"I like the fact that the haptic reminders were private to the chairs and speakers, when used appropriately"* [HS_{aud}50], and *"I liked that as an audience [member] I wasn't involved in the timing issues of the presenter"* [SM_{aud}9]. Contrary to this, however, visibility may sometimes be needed for adding social pressure, *"I also like having an audible alarm at the end of the Q&A time as this applies some social pressure for the speaker to stop"* [HS_{chair}4]. At the GR

2MM session, the session chair explicitly made speakers' timing information public on the projector screen to increase social pressure. $SM_{chair}4$ similarly suggested, *"the final signal that 'time is up' should be visible to all…the public as well."* With haptics, requiring acknowledgement rather than allowing it to be optional (the current approach) may add social pressure; that is, forcing speakers to explicitly stop each haptic notification, as 3 of the session chairs (2 HS, 1 SM) suggested.

Minimally captures attention. Few speakers (24% [5/21], 27% [3/11], 18% [4/22], 33% [1/3]) and only 1 HS chair reported the haptic notifications to be distracting. Audience members also felt less distracted, *"Haptic reminders are less distracting for the audience, and the speaker cannot miss it"* [$HS_{aud}14$].

Meanwhile, the visual sign notifications at HS caused visible speaker distractions: speakers were often found glancing at the sign, nodding to the session chair, verbally commenting about receiving the reminder, and pausing or stumbling in their speech. For example, $HS_{spk}16$ stopped to say *"Ok"* in the middle of presenting to the session chair who missed his initial head nod. Sometimes, the speaker even glanced at the sign twice. $HS_{aud}6$ commented, *"What's distracting is the fact that the speaker has to make eye contact with the person holding the paper. That takes the attention away and interrupts the speech for at least 1-2 seconds."* Audience members also found the act of seeing the paper signs and the anticipation of when the speaker actually sees them distracting: *"I found the paper very distracting…I was watching the signs and waiting to see when the speaker would notice it. Shared anticipation. It would also throw off the flow of the talk in some cases"* [$HS_{aud}15$], *"I want to listen to the talk. It stresses me out to realize that the speaker may have lost track of time and might speak too long"* [$HS_{aud}19$], and *"The focus was pulled from the speakers content to the fact that they were missing their note, sometimes for minutes. The chair had to then update their reminder card"* [$HS_{aud}37$]. With HaNS, this distraction is removed because the audience members do not know when the haptic notifications are actually being delivered, unless the speaker mentions them; therefore, there is never a period when the audience is wondering how long it will take the speaker to notice a reminder.

Furthermore, it was often difficult for HS session chairs to remember which speakers they had to deliver the visual signs to because not all speakers in a session participated. Thus, 7 HaNS speakers ended up occasionally receiving the visual sign notifications as well. Upon receiving a visual sign notification, these speakers nodded firmly or quickly to the session chairs to indicate they were already aware of the time as a result of the haptic notification they received just seconds earlier, or nodded before the session chairs even got a chance to hold up the visual sign. As $HS_{spk}1$ said, *"I felt that I had to acknowledge the reminder to the chair because he or she was holding a sign. It wasn't necessary however so I would have preferred the chair not to have a sign and not having to acknowledge."*

Audience was largely appreciative. The only negative comments received regarded aspects of HaNS that could easily be improved upon, and not about the notifications themselves: *"My attention was drawn to the large device on their wrists. If it were smaller or invisible, this would not be an issue"* [$HS_{aud}16$], *"No. I couldn't notice them [haptic notifications]. A few speakers mentioned they were being buzzed, but I think they did so mostly to be funny"* [$HS_{aud}19$], and *"[The] session chair's monitor was in my field of vision"* [$SM_{aud}9$].

Overall, audience members responded positively to HaNS and felt that the sessions were generally well run. GR audience tweets included: *"Looking forward to seeing the PNIs [principal network investigators] getting electrocuted!"* [$GR_{aud}1$], *"Wow, the 2-minute madness is serious. Haptic bracelets to shock people when they've hit the time limit"* [$GR_{aud}2$], and *"Crank up the charge on the out-of-time devices!"* [$GR_{aud}3$] Audience members also positively commented: *"The adherence to schedule was high without the normal 'verbal harassment'. Not sure how the speakers felt, but it was great as a conf[erence] attendee"* [$HS_{aud}9$], *"It seemed as though presenters with the haptic reminders tended to be more on time than those without"* [$HS_{aud}10$], *"Haptics is much better!"* [$HS_{aud}19$], *"This is a great use case for haptics in my opinion. It's unobtrusive to the audience yet noticeable to the speaker without them having to look and respond"* [$HS_{aud}26$], and *"All seemed to be on time. I think the haptic reminders were effective for this purpose as some of [the speakers] mentioned trying to keep up with their time"* [$SM_{aud}4$].

Chair-speaker channel was viable and utilized. Most chairs felt that haptics was better than the standard ways of reminding speakers of the time (79% [11/14], 100% [5/5], —, —) and helped with their chairing duties (93% [13/14], 100% [5/5], —, —). In fact, 91% [10/11] of the HS session chairs who both wore the haptic device and delivered paper sign reminders felt that haptic notifications were better than the paper signs at reminding speakers of the time. The value of chair-speaker communication was evident when 2 HS session chairs used the overtime button on HaNS's timing console (shown in Chapter 3 – Figure 3.2) to send additional notifications to speakers who were overtime. The speakers quickly concluded their talks upon receiving these notifications, *"When one speaker went over I buzzed him again and it was clear that he really got the message!"* [$HS_{chair}14$] This function was also flagged as useful in the Q&A period because speakers occasionally take a while to answer a question, so by receiving a haptic notification, they are signaled to wrap up or stop. Two HS audience members commented on how, when things usually dragged on, it was mainly because speakers kept talking during the Q&A period, *"I wonder if the session chairs could give the speaker a little buzz when s/he is too long-winded in answering a question"* [$HS_{aud}21$].

Additionally, using haptics for the chair-speaker channel develops a shared understanding of the notifications. For example, since session chairs feel the same notifications as speakers, not only do they receive the same timing information, but feeling the vibrations themselves may prevent them from abusing the overtime feature on the timing console.

Weearability allowed freedom of movement. HaNS does not depend on its proximity to the users wearing the haptic devices. On the other hand, looking around the room causes visual notifications to be easily missed, and moving or walking around pulls speakers and session chairs away from their timing tool if it is on the podium or chairing table: *"I can't prop [the cellphone] up to face me, it lays flat on the table / lectern in front of me"* [$SM_{spk}6$] and *"I have to be standing close enough to the laptop at the time"* [$CL_{prof}3$]. Visual notifications can also be hard to read if they are too far, *"In some lecture rooms the clock is too far away…or located where it is not easy to see with a glance"* [$CL_{prof}2$]. Some speakers noted that HaNS untethered them – *"Having [the device] on my wrist allows me to walk around the presentation space"* [$SM_{spk}9$]. Similarly, session chairs,

particularly at HS, found the haptic notifications helpful while standing away from the chairing table: *"During the Q&A session I left the chairing table where the laptop with timing information was. Because I had set a 1 min reminder for both the speaker and myself prior to the end of the one-hour session it was possible for me to gracefully end the Q&A session without glancing at my watch or run back to the chairing table"* [$HS_{chair}2$].

HaNS cues created opportunities for improved timing. Several instances of HaNS helping speakers adjust their pace such that they neither finished too late or too early were observed. For instance, upon receiving the 3-minute notification, $HS_{spk}14$ was already on his conclusion slides and mentioned that he was a bit fast. He thus took the next 2 minutes and 16 seconds to elaborately summarize his talk. $SM_{spk}9$ who went the most overtime still skipped through a number of slides while making comments like *"I'll skip over this part"*. $HS_{spk}16$ even accidently prepared a 15-minute presentation, not realizing it was supposed to be 12 minutes until the session had started. Despite this mistake, this speaker selectively skipped content and managed to finish only 24 seconds overtime. Similarly, $GR_{spk}18$ mentioned, *"While I personally went overtime, it was only by a few seconds, AND it would have been more if not for the reminder system. Based on the half-point reminder, I realized I was behind and I therefore left out some material and speeded up my speaking pace."* HaNS was also able to convey timing information in the absence of notifications; although $SM_{spk}10$ did not carefully time her talk beforehand and finished 5 minutes and 51 seconds under her allotted talk time, the absence of notifications helped her infer that she had talked much faster than anticipated. However, not all speakers may want to fully utilize their time; rather than using the extra time to present other content, $SM_{spk}10$ simply ended her talk early. Furthermore, all the HS and SM HaNS speakers who finished their presentations early did not use any additional timing tools; HaNS was their only source of time.

Users saw value for HaNS 'internal' presentation control. Most speakers (81% [17/21], 82% [9/11], —, 67% [2/3]) and session chairs (86% [12/14], 100% [5/5], —, —) were satisfied with the haptic device in helping them keep track of time. Although noticeably more for HS and SM, many speakers (86% [18/21], 82% [9/11], 50% [11/22], 67% [2/3]) and session chairs (93% [13/14], 100% [5/5], 100% [1/1], —) also agreed the device would be useful in a future presentation or session. Even most chairs felt the device was better than their personal timing tools for tracking speakers' time (86% [12/14], 100% [5/5], 100% [1/1], —). However, fewer speakers agreed (67% [14/21], 36% [4/11], 41% [9/22], 67% [2/3]). In particular, $CL_{prof}1$ was not overly satisfied with HaNS. It was only on his last day of wearing HaNS that he felt HaNS would be useful for future lectures and better than his usual timing tools. On that day he used a much simpler notification scheme than in his previous lectures. In its current form, HaNS seems to be appreciated somewhat more by chairs than speakers.

4.2.5 HaNS — Improvements Based on User Feedback

Responses from and observations of users and audience members indicated ways in which HaNS can be improved.

Full utility of haptic cues may take practice. The haptic notifications were intended to help users infer the time remaining from the haptic patterns alone, without additional visual support (Chapter 3 – Section 3.3.2). While many chairs found the notifications easy to understand (79% [11/14], 80% [4/5], 100% [1/1], —), fewer speakers agreed (76% [16/21], 45% [5/11], 59% [13/22], 100% [3/3]). When speakers were asked about how they remembered the meaning of the notifications, speakers seemed to use a combination of the haptic patterns (57% [12/21], 64% [7/11], —, —) and the order of the notifications (71% [15/21], 64% [7/11], —, —) to understand which notification they were getting. However, by comparison, all 3 CL participants generally found the haptic patterns easy to understand despite the large number of notifications they received. This suggests that learning the mapping may just require more than one exposure, *"With a couple more uses the understandability would have been no problem at all"* [$GR_{spk}18$].

Physical device should be smaller and more versatile. Designed for robustness, the haptic devices were no doubt much larger than the ideal size. They could be seen by the audience. Not surprisingly, quite a few post-survey participants (40% [23/57] – speakers, 55% [11/20] – session chairs) commented on the bulkiness of the device, preferring something much smaller and lighter that could easily fit under the sleeves of clothing. Two participants, $HS_{chair}9$ and $CL_{prof}2$, decided to wear the haptic device on their right ankle midway through the study. $HS_{chair}9$ felt such a system should be wearable at multiple locations and not just the wrist: *"At some points I put it in my pocket, on my ankle, I sat on it and strapped it to my belt. All these other places were better than at the wrist. The ankle was good…but it's hard to ask [people] to do that."* $CL_{prof}2$ wanted to find a more comfortable location for the device. Both were still able to feel the notifications.

Notification acknowledgement is visible and not always sufficiently sensitive. Acknowledgement was optional, but some speakers did touch the device sensor to stop the vibrations (24% [5/21], 27% [3/11], —, —). This was externally noticeable. The gesture required a two-handed gesture that could be easily noticed from afar, especially if the speaker exaggerated the gesture. Five other HaNS speakers (4 HS, 1 SM) preferred to let the chair know that they were aware of the time through a simple head nod or eye contact, but these gestures were similarly noticed by the audience. Furthermore, although the device's FSR sensor was designed to be sensitive to very light touches, some touches were still missed as some nervous speakers quickly brushed the top of the device. As a result, some speakers were required to repeat the acknowledgment gesture to stop the notification. Those who exaggerated the gesture may have done so as an extra precaution for ensuring their touch was sensed.

Advanced session timing support. This version of HaNS was limited to only monitoring the presentation time, similar to an ordinary timer. Not only did HS session chairs complain about this as it was cumbersome to reconfigure the timer for each speaker whose talk lengths varied between 8 and 12-minutes, but the total session time, Q&A periods, and the time needed to start or conclude a session, introduce or thank speakers, and for transition periods between the talks, questions, and speakers were all unaccounted for. Session chairs are

constantly re-evaluating the progress of a session as they chair: *"A session chair has to solve a constraint satisfaction problem in the way that is the most 'fair' to the speakers and audience. The Q&A will typically not be of fixed duration, hence, use the session chair's judgment"* [SM_{chair}4]. All the HS session chairs repeatedly checked the conference program to figure out whether a session was running on schedule. Chairs may also take the opportunity to get back on time if questions end early, or lump the talk and Q&A times together so that if a speaker went overtime in his/her talk, the chair would adjust the amount of time dedicated for questions. However, HaNS did not accurately reflect these details, leaving them up to the session chair to estimate and manually adjust. In fact, even the HS conference program itself did not account for all of these timing details resulting in all of the scheduled sessions starting and ending late.

4.2.6 HaNS — Limitations of External Speaker Reminders

HaNS is modeled after existing speaker reminders, which focus solely on 'external' speaker management. However, there are several limitations that are likely to be common to any scheme emphasizing this approach. Most significantly, it does not incorporate speakers' need to *internally* strategize pacing and thereby avoid overruns.

Practice is needed to effectively utilize notifications. Many SM but fewer HS speakers felt satisfied with the overall pace of their presentations (52% [11/21], 82% [9/11], —, 100% [3/3]) and felt their presentation went well (57% [12/21], 100% [11/11], —, 100% [3/3]). A similar trend was found among chairs in regards to their satisfaction with the session's timing (43% [6/14], 100% [11/11], 100% [1/1], —) This suggests that aspects of a setting such as formality and time restrictions may factor into how one evaluates the outcome of a presentation. Additional practice with HaNS might allow speakers to better utilize an improved time awareness: *"I think the device makes sense only if the presenter had also done his practice with it…I think the only reason that I like [my presenter tool] is that I have practiced with it… during practice I get to know what time I should be [at] when I am on slide X"* [SM_{spk}11] and *"I would need to have practiced with [the haptic notifications] for them to have been useful"* [GR_{spk}23].

Choosing appropriate notifications requires familiarity. While the notification time points were standardized for HS paper session speakers, HS keynote and all the SM speakers (Section 4.1.1 – Table 4.1) were allowed to choose their own notification scheme. In the post-survey, speakers were asked if they preferred an alternative notification scheme: about half of the speakers suggested different times to be notified (48% [12/25], 45% [5/11], —, —). Speakers commented, *"The half way reminder was the most useful because I didn't really have any sub-timings practiced for my talk"* [SM_{spk}9] and *"If I had timed my presentation during my practice…then I could probably choose more meaningful reminders"* [SM_{spk}11]. The key role of practice was particularly noted among the CL participants who almost had a different notification scheme for every class (Section 4.1.1 – Table 4.3). In particular, by the end of the study, CL_{prof}1 still felt the wall clock was more useful because he could check it whenever he wanted without being interrupted. However, on his last class of

using HaNS, he did find that getting notified every 10 minutes was helpful as it helped him loosely gauge the progress of the class, and reminded him to look at the clock. He was able to develop over time a notification scheme that worked for his style of teaching.

Fine-grain timing must also be available. HaNS seemed to function by providing an indication of progress; 13 HaNS speakers (10 SM, 3 CL) commented that the notifications especially helped them by allowing them to decide whether their talk was going too slow or too fast. The notifications also seemed to prompt participants to check the time if needed as all of the session chairs were seen doing, *"If it vibrated, I noticed it and could see the big countdown clock that was on the screen"* [$GR_{chair}1$]. Interruption-based notifications may work well for session chairs who can easily glance at the time if needed, which may be why the majority of session chairs felt they could chair without monitoring the time while using HaNS (71% [10/14], 100% [5/5], 0% [0/1], —). On the other hand, because HaNS was not able to provide granular timing information in between notifications, many speakers still felt a need to monitor the time even while using HaNS, especially as they approached the final seconds of their presentation (43% [9/21], 18% [2/11], 55% [12/22], 100% [3/3]). Several speakers, particularly CL participants, were seen checking their timing tools or even instinctively looking at the haptic device as if it were a watch to check the time. All 3 CL participants reported requiring precise timing information because they actively gauge how much class time remains in order to manage content and exercises accordingly. Seven GR speakers especially reported relying heavily on the visual timer in front of them, and 5 suggested that the haptic device would be most useful in conjunction with a visual clock. Other comments by GR speakers included, *"The first [haptic] cue was the most useful – the 1 minute warning, because it gave me a sense of overall timing. The second one cued me to start monitoring the actual clock. The final haptic cues were less useful since I needed precise countdown information"* [$GR_{spk}2$], *"The haptic tool helps remind me to consider the time while the visual clock is more precise"* [$GR_{spk}9$], and *"This probably was not the best test of the device, because I relied heavily on the digital clock in front of me, which allowed me to time my talk down to the last second"* [$GR_{spk}22$].

For the above reasons, a small number of HaNS speakers additionally used a personal timing tool (10% [2/21], 27% [3/11], —, 100% [3/3]), as did some HaNS session chairs (29% [4/14], 20% [1/5], 100% [1/1], —). For the HS session chairs, the secondary timing tool came in particularly handy during the Q&A period because it allowed them to continually assess the time remaining for questions.

Delivering notifications according to progress. With HaNS and speaker reminders in general, notifications are sent regardless of a speaker's progress. This means that if speakers realize they are actually going faster than they expected, they may use the extra time to elaborate on their talk as the observations showed. However, there may be instances where speakers only want to receive reminders when they are behind as two speakers mentioned, *"I prepare my talks well so the [visual sign] reminder is usually not necessary. It also often appears at a point where I am clearly wrapping up the talk...If I'm running late and almost out of time give me a strong reminder. If I'm doing fine leave me alone!"* [$HS_{spk}1$] and "*Because of the haptic reminder I noticed [I was early], which on the one hand allowed me to react and use some extra time late in the presentation but on the*

other hand distracted me" [HS_{spk}14]. At least 5 speakers (3 HS, 2 GR) and 6 session chairs (5 HS, 1 SM) suggested that a timing system should automatically gauge progress for you: *"In some scenarios, it may be more important to know whether you are ahead-of-time or behind-time at a particular point in a presentation, rather than knowing that there is one minute left"* [GR_{spk}14].

In a manual system, session chairs may be able to tell if a speaker is wrapping up and choose not to deliver more reminders, but these cues are not always obvious. The notifications may even occur at a point when the speaker is in the middle of something complicated, *"It isn't so much that [the haptic notification] is hard to remember, it depends really more on when it is…If I'm in a point in time where I'm not in the middle of doing something then the haptic reminders are great…If I'm in the middle of doing something complicated, then it's kind of a bother because then I have to think about ok which one was this"* [CL_{prof}1]. Again, session chairs may be able to hold off on delivering a notification, but this further adds to the inaccuracy of their visual signs as more time passes. Thus, the ability to gauge a speaker's progress and handle notifications occurring when a speaker is early or in the middle of doing something are currently unsupported by both HaNS and speaker reminders.

Importance of personalization. Participants varied considerably in their perceptions of how the haptic signals should be improved, suggesting that personalization may be the best way forward. With HaNS, the haptic notifications can theoretically be customized, whereas a speaker cannot reasonably personalize how a chair delivers reminders. For example, at least 6 GR HaNS speakers mentioned that they could feel the notifications during the demo and while waiting in line, but not when they were actually presenting. With HaNS, the vibrations could be made stronger to be more easily noticed, and this intensity could be tailored through practice. In fact, 7 speakers (1 HS, 3 SM, 3 GR) said the vibrations should be stronger, while 2 (HS) wanted them weaker. Four speakers (2 HS, 2 GR) and 3 HS session chairs felt the notifications were too long or short, or that there were too many signals. Furthermore, 16 speakers (7 HS, 4 SM, 5 GR) made suggestions on how to improve the haptic mappings, for example: *"make the reminders the same for each time"* [HS_{spk}21], *"make them more mapped to the time remaining…3 low vibrations for 3 minutes remaining, one short but stronger for 1 minute remaining, and a long one for the end"* [HS_{spk}28], *"make them more meaningful – 1 pulse for halfway, 2 pulses for the second buzz, 3 pulses for the third buzz"* [SM_{spk}5], and *"perhaps increase duration as time diminishes"* [GR_{spk}20]. Six session chairs (5 HS, 1 GR) also made similar suggestions.

Personal control over timing. A few speakers (1 HS, 1 SM, 2 GR) explicitly expressed a preference for controlling timing themselves. HS_{spk}1 mentioned, *"The [haptic] device requires trusting the chair to use it correctly. I would have perhaps preferred to program [the notifications] myself."* Particularly in more informal settings such as the SM setting, speakers may want control over *"choosing when to start [the time], being able to pause or extend time depending on the interactivity of the audience"* [SM_{spk}3]. Personal timing control also allows users to use the timing system in a manner that is familiar and comfortable to them.

Chapter 5

Discussion

The evaluation presented in this thesis investigated HaNS's feasibility as a replacement for traditional speaker reminders. The diversity of the evaluation settings, in formality, length, and type, afforded a glimpse of where it has immediate value and *how* it works with users.

HaNS executes two primary operations to facilitate chair-speaker communication: *timing automation*, wherein timing management is offloaded from the chair, and *reliable and private* (because they are haptic) *reminder delivery*. Although each could theoretically provide benefits alone, our particular interest is in the sensory, cognitive, and social outcomes of their interplay and context. For example, to the extent that HaNS cues intrude, they may with continued use become more comfortable because (due to automation) they can be highly consistent, unlike systems that vary in delivery and receipt. Similarly, the speaker's workload benefit due to optional acknowledgement is only available when the chair can assume confirmed on-time delivery of salient signals (requiring both HaNS operations).

Furthermore, one of the primary insights pertains to external versus internal loci of speaker timing control, and how HaNS (automation and notification) might also be well suited for internal control – in essence, slicing HaNS operations a different way to facilitate a *system*-speaker rather than *chair*-speaker loop – personalized if possible.

These themes guide the reflections presented in this chapter on what has been learned about touch-based reminders and speaker control.

5.1 Haptic Modality

The need that triggered this research was for salient, unintrusive notifications that can be delivered privately and remotely, a standard which HaNS cues appear to meet. Further benefits of automating delivery and potentially, of personalizing timing, signal content and other reminder behaviors have been identified. Validation with other modalities is needed, but inherent attributes of touch (as laid out below and in the Related Work) make it the ideal for this context. However, its optimal design is not without subtleties.

5.1.1 Individuals and Contexts Vary in Perceptual Capacity

People's differing sensitivity to touch, accentuated by context and cognitive load (Feige, 2009; Karuei, et al., 2011; Oakley & Park, 2008), could explain why a few participants found the notifications hard to notice. Tactile sensitivity also drops with movement (Post et al., 1994), impacting mobile speakers particularly. Cognitive theories agree that any perceptual modality will 'miss' under extreme sensory loads, so it is understandable that in the frankly chaotic GR setting, fewer speakers noticed HaNS cues (the rock music generally got through). Together these point to both personal and contextual tuning of signal loudness, to maximize the population that can benefit.

5.1.2 Novices Can Process Simple Haptic Information Immediately; Potential for Expert Usage with Training

While some of our speakers had familiarization time, few got to really practice using HaNS cues. Nevertheless, most seemed to easily find adequate mnemonics based on a combination of order and signal characteristics; the signal mapping alone was not generally enough. However, humans can process tactile information (Klatzky et al., 1985; Klatzky et al., 1987) even while under high cognitive load (Brewster & Brown, 2004; Hyun et al., 2011; Spence et al., 2004; Tang et al., 2005), and with training, are able to parse haptic signals more proficiently (Töyssy et al., 2008). There is thus reason to expect that with training this already promising performance standard might rise, further lowering mental workload and signal utility.

5.1.3 Social Factors Generally Improved

Most chairs valued relief from the social responsibility for delivering and confirming receipt of speaker reminders that accrued from HaNS's automation and privacy. We also wondered, if, when a speaker's time remaining is not publically broadcasted, reduced social pressure would allow speakers to conclude more elegantly, or conversely, be less mindful of finishing on time. The evaluation showed that speakers do generally value the importance of presentation timing, and audience members prefer not to be distracted by a speaker's timing issues; however, actual timing performance probably requires more practice to improve. In cases where speakers do need additional social pressure, chairs could supply it with additional, more persistent or more public notifications.

5.2 Inherent Nature of External Speaker Control

HaNS was initially envisioned as a reliable mechanism for chairs to police speakers. In retrospect, it is thus not surprising that we found a disconnect between chair and speaker responses to a number of questions: on average a greater percentage of chairs were positive relative to speakers. We have three key explanations for this. First, some speakers, who are in a higher stress situation than chairs, would simply prefer not to be controlled. While HaNS was intended to improve speakers' awareness of time relative to traditional chair

reminders (e.g., signs), it is still a form of control. The second and third reasons relate to what speakers likely need to facilitate their *internal* control, namely affordances and personalization, as described next.

A lower fraction of speakers reported a preference over their usual timing tools (51%) or expected to rely on it alone (57%), relative to the session chairs (89% and 79% respectively). While HaNS offers some unique affordances to speakers (e.g., ability to leave the podium, not reliant on visual attention), it also lacks some key affordances of personal timing tools, most notably access to fine-grain timing information. This was an issue for some speakers, particularly GR and CL participants.

It is likely that the very individual strategies that speakers use mean that cue timing, signal content, and loudness need to be personalized, and practiced. Even after a single use, many speakers preferred different notification points, signal mappings, and other customizations. CL participants, in particular $CL_{prof}1$, were very used to polling for timing information, and they required several classes of using HaNS in order to best incorporate its notifications into their teaching. Similarly, most participants have likely had multiple exposures to their personal timing tools and have worked out strategies over time on how to best use them, mitigating their weaknesses as much as possible. Other than in the CL setting, participants did not have the chance to do this with HaNS. HaNS has many personalization opportunities: anecdotally, colleagues who have informally used HaNS several times and with customization mention increasing ability to *learn how to make use of it.* One can even imagine that extremely short talks with down-to-the-second timing could be an ideal use case for a practiced, attuned user.

5.3 Challenges of Doing Evaluation In-the-Wild

Some of the challenges inherent to iterating and evaluating in naturalistic presentation settings are elaborated here with suggestions on how they might be addressed in future studies.

Recruitment. Given the novelty of the system and its *potential* disruptiveness to a presentation made it difficult to recruit participants. Recruitment emails were intentionally personalized and individually sent to each speaker well in advance of their presentation to encourage participation. However, many speakers still chose not to use HaNS. Providing a video demonstration of the system and additional demo opportunities where speakers could actually practice while using HaNS may mitigate concerns and increase participation. Allowing speakers to control parts of the system may also provide further reassurance.

Study control. An obvious limitation with running the study in a naturalistic presentation setting is that there was a lack of control from participant to participant. Each participant may have had a different experience as sessions varied in terms of audience, session chairs, and even room setup. Even within a single session, there were unplanned events that occurred for some participants, but not others. Furthermore, although the full study details were sent out well in advance to participants, they were probably not fully read. The time available for demoing HaNS was also limited to demo sessions and even the beginning of a session, resulting in some participants getting more practice than others. Some participants were in a rush and may not have paid much attention during this process. Thus, the study details and procedures were not consistently understood across all participants. While the variation across sessions may have broadened our insights into the possible occurrences

within the presentation context, perhaps the instructional and demo processes could be more controlled. For instance, even though HaNS was intended to be intuitive and quick to learn allowing for last minute participation, perhaps speakers and session chairs should be required to spend a fixed amount of time with the experimenter before they participate.

Full and well-balanced participation. Similar to the above point, as a way of encouraging participation and accommodating participants' schedules, participants were allowed to take part in only a subset of the study components. However, this made the analysis difficult. For instance, some participants used HaNS but did not complete the post-study survey. Thus, these speakers' experiences were not captured. Reducing the amount of time needed for completing surveys could be one solution. Another approach may be to offer more incentive for full participation. For example, a video copy of the participant's presentation could be provided upon completion of the post-study survey. Also, there were very few non-HaNS participants. This made it hard to capture a lot of non-HaNS experiences. Recruitment efforts geared towards this participant pool could be strengthened in the future.

Iterative design. Even though we took a highly iterative approach to designing HaNS, we were still unable to adequately test the full system before running the actual study in a real conference setting. Many of the conference-specific requirements were initially gathered through pilot participants' past experiences. However, this did not capture all of the users' needs as several areas requiring improvement were found during the full evaluation. The design guidelines generated from this research intend to form a basis for the next version of HaNS.

5.4 Limitations

It seemed crucial to test HaNS with real speaker and session chair stressors and goals, and thus embarked on this ambitious study 'in the wild' where there was limited control. This did constrain our conclusions. It is also hard to know if our participants in haptics and new media (HS and GR) were more receptive towards this intervention than others would be, or more critical given expertise and a concern for 'getting it right.' Controlled realistic tests will not become easier; voluntary uptake may be the best future indicator of usability.

Chapter 6

Implications for Design

The evaluation has guided this research towards design recommendations when implementing a future automatable timing notification system. This chapter itemizes the requirements for jointly optimizing the apparently conflicting needs of a session chair and a speaker.

6.1 Implications for HaNS Design

The list merges our starting requirements, as presented earlier in Chapter 3, and those that our evaluation has now confirmed, and new requirements that emerged, applicable towards any sensory modality. It begins with the more demanding needs of the speaker, many aspects of which the chair shares, and adds criteria that apply to the chair alone

6.1.1 Speaker

The following are design guidelines, relevant to both speakers and session chairs and a variety of presentation settings:

- *Above all, must be easy and automatic.* Processing notifications must use minimal effort. Cues should be easy to notice and understand, yet impose minimal distraction, cognitive disruption or startle effect. Even small amounts of practice should lead to non-conscious signal processing. Setup and training must require almost zero effort.
- *Acknowledgement should be optional*. If used, it should be an extremely quick, easy, private motion that is nevertheless immune to accidents. Users should receive feedback that their acknowledgement was received.
- *Develop avenues for speakers to personalize and practice*, *even in a conference setting*. Settings for notification points, intensity, duration, and signal mapping could be part of a user profile, set up online in advance during a familiarization session. As tactile notifications become standard practice, on-site rehearsal may become unnecessary while personalized settings become imperative.
- *Private is better.* Minimize audience awareness of notifications, physical wearable, and any acknowledgement.

- *Coordinate detailed visual backup.* More fine-grain timing information should be available in a way that complements the tactile notifications.
- *Must be wearable, wireless, and comfortable.* Should flexibly accommodate a diversity of presentation settings and body sizes, and never impede movement. Signals need to be perceptible even with movement, and the unit itself must be accessible for any required manual interaction.
- *Reliability is essential.* All aspects of the device must be fail-safe – users must be able to absolutely rely on it.

6.1.2 Session Chair

The following are additional features that a chair-speaker timing system (haptic or otherwise) should support:

- *Echo the speaker's experience.* Send the same signals to the chair as the speaker, for the chair's time awareness and to replace lost external signs of the communication loop.
- *Provide an additional direct, yet private communication channel.* Allow the chair to provide additional reminders, and other elements such as when the timer has started and when Q&A is over. Likewise, allow the chair to escalate communication to a public level, to apply additional social pressure when needed.
- *Make the timing system setup seamless and flexible.* While our chairs could only set up a single talk at a time, they wanted to set up a whole session, including the Q&A, to easily adjust timing as the event proceeded, and monitor progress against larger timing targets.

Chapter 7

Conclusions and Future Work

This thesis presented research on the design, implementation, and evaluation of a wireless wrist-worn Haptic Notification System (HaNS) that can unobtrusively help speakers and session chairs manage the timing of oral presentations. Its use was explored in four evaluations across three types of presentation settings. This final chapter summarizes the contributions and suggests several ideas for how haptics can be further explored to support presentations.

7.1 Summary of Contributions

HaNS, a novel wireless, wrist-worn chair-speaker communication system, uses automation and tactile alerts to facilitate the time-managing of oral presentations. Through field observation, HaNS was found to positively modify the chair-speaker loop, even to the point of making speaker confirmation optional. It achieves this through reliable notification delivery, cognitive offloading, and channel privacy. HaNS can also improve time awareness.

A deeper look at the inherent mismatch between traditional *external* speaker control and more effective speaker *internal* control leads us to consider how HaNS could allow both players to manage their own experience. In particular, a speaker who personalizes and practices with the reminder system may be better able to use notification-derived time awareness to actually improve talk timing. Feedback from the longitudinal observations of HaNS in a classroom lecture setting (CL) suggests this to be the case.

Finally, this research has led to general guidelines for a future haptic-based or other modality-based notification system, and resulted in suggestions on how future related work in naturalistic presentation settings might be approached.

7.2 Future Work

While the research focus was on haptic-based oral presentation timing solutions, there are no claims that haptics outperforms other modality-based solutions. However, given its potential, a very interesting next step is to fully compare haptics against other modalities to see which is most effective and feasible for speakers. This research with haptics could also be furthered within the presentation context by investigating the following:

- *A haptic icon library for speakers.* Three haptic patterns were designed for the study, but as the results showed, these may not be the most intuitive for a speaker to remember. Further work is needed to explore and develop a suite of haptic icons that are best suited for speakers while presenting.
- *Providing additional timing information haptically.* It would be interesting to see if a speaker could poll for precise timing information using haptics, rather than requiring visual support.
- *Notification acknowledgement.* More subtle ways for speakers to acknowledge notifications to session chairs are needed. It would also be valuable to learn how the private chair-speaker channel could be further exploited through haptics.
- *Alternative haptic forms.* While the haptic device was built for the wrist, other devices and body locations may be effective as well. For instance, a shaken floor or podium, or sending haptic notifications through a presenter remote, phone, or other items that a speaker might use while presenting. Building a haptic device that could be easily connected to via Bluetooth with its timing application available for download might be another approach.
- *Haptic notifications for progress evaluation.* It would be useful to learn how a system like HaNS can automatically gauge progress for speakers and session chairs, and let them know with haptics when they are ahead or behind.
- *Other uses for attentionally optimized notifications.* While the study used haptics for presentation timing, there could be other non-timing related situations where attentionally optimized notifications are needed.
- *Haptic notifications for the classroom.* Further work is needed to explore how haptics could be designed to increase classroom interactivity and better aid a lecturer while teaching. For instance, haptic notifications would be useful for letting the lecturer know immediately when there are technical difficulties or when students are confused with a concept. Similarly, if the lecturer is writing on the whiteboard, students who have a question could get the lecturer's attention without him/her having to turn around. Upon receiving a notification, the lecturer could then decide whether s/he wants to answer the question right away or finish with what s/he was teaching first.
- *The evolution of a haptic notification system due to cultural shifts.* Finally, it would be interesting to observe how the current chair-speaker paradigm might shift overtime as automatic and/or tactile systems like HaNS become widely adopted, and how the design of a notification system might evolve to reflect these ongoing cultural shifts.

Bibliography

AB (Baseline And Intervention) Design. (2000). *Introduction to single subject designs*. Retrieved September 1, 2011, from https://www.msu.edu/user/sw/ssd/issd10b.htm

Allen, M., Gluck, J., Maclean, K., & Tang, E. (2005). An initial usability assessment for symbolic haptic rendering of music parameters. *Proceedings of the 7th international conference on Multimodal interfaces*, ICMI '05 (pp. 244–251). New York, NY, USA: ACM.

Arduino Fio. (2012). Retrieved September 11, 2011, from http://arduino.cc/en/Main/ArduinoBoardFio

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In K. W. Spence, & J. T. Spence (Eds.), *The psychology of learning and motivation* (Vol. 2, pp. 89–195). New York, NY: Academic Press

Atkinson, R. C., & Shiffrin, R. (1969). Storage and retrieval processes in long-term memory. *Psychological Review, 76,* 179-193.

Bachvarova, Y., van Dijk, B., & Nijholt, A. (2007). Towards a unified knowledge-based approach to modality choice. In *Workshop on Multimodal Output Generation,* 7-15.

Baddeley, A. D. (1992). Working memory. *Science,* 255.

Baddeley, A. D. (1999). *Essentials of human memory*. Hove, England: Psychology Press.

Baddeley, A. D., Eysenck, M., & Anderson, M. C. (2009). *Memory*. Hove, England: Psychology Press.

Baddeley, A. D., & Logie, R. H. (1999). Working memory: The multiple component model. In A. Miyake, & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 28-61). New York, NY: Cambridge University Press.

Bau, O., Petrevski, U., & Mackay, W. (2009). BubbleWrap: a textile-based electromagnetic haptic display. *Proceedings of the 27th international conference extended abstracts on Human factors in computing systems*, CHI EA '09 (pp. 3607–3612). New York, NY, USA: ACM.

Baumann, M. A., MacLean, K. E., Hazelton, T. W., & McKay, A. (2010). Emulating human attention-getting practices with wearable haptics. In *Proceedings of IEEE Haptic Symposium*, HAPTICS '10 (pp. 149-156). Waltham, MA, USA: IEEE Computer Society.

Bosman, S., Groenendaal, B., Findlater, J. W., Visser, T., de Graaf, M., & Markopoulos, P. (2003). Gentleguide: An exploration of haptic output for indoors pedestrian guidance. *Lecture Notes in Computer Science,* 358-362.

Brewster, S., & Brown, L. M. (2004). Tactons: structured tactile messages for non-visual information display. *Proceedings of the fifth conference on Australasian user interface - Volume 28*, AUIC '04 (pp. 15–23). Darlinghurst, Australia, Australia: Australian Computer Society, Inc.

Brown, L. M., Brewster, S. A., & Purchase, H. C. (2005). A first investigation into the effectiveness of tactons. *Proceedings of the First Joint Eurohaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, WHC '05 (pp. 167–176). Washington, DC, USA: IEEE Computer Society.

Brown, L. M., Brewster, S. A., & Purchase, H. C. (2006). Tactile crescendos and sforzandos: applying musical techniques to tactile icon design. *In extended abstracts on Human factors in computing systems*, CHI EA '06 (pp. 610–615). New York, NY, USA: ACM.

Brown, L. M., & Kaaresoja, T. (2006). Feel who's talking: using tactons for mobile phone alerts. *In extended abstracts on Human factors in computing systems*, CHI EA '06 (pp. 604–609). New York, NY, USA: ACM.

Burle, B., & Bonnet, M. (1999). What's an internal clock for?: From temporal information processing to temporal processing of information. *Behavioural Processes*, *45*(1–3), 59–72.

Cao, Y., Theune, M., & Nijholt, A. (2008). Modality effects on cognitive load and performance in high-load information presentation. *Proceedings of the 13th international conference on Intelligent user interfaces*, IUI '09 (pp. 335–344). Sanibel Island, Florida, USA: ACM.

Casini, L., & Macar, F. (1999). Multiple approaches to investigate the existence of an internal clock using attentional resources. *Behavioural Processes*, *45*(1–3), 73–85.

Chan, A., MacLean, K., & McGrenere, J. (2005). Learning and identifying haptic icons under workload. *Proceedings of the First Joint Eurohaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, WHC '05 (pp. 432–439). Washington, DC, USA: IEEE Computer Society.

Chan, A., MacLean, K., & McGrenere, J. (2008). Designing haptic icons to support collaborative turn-taking. *International Journal of Human-Computer Studies*, *66*(5), 333–355.

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction*, 8.

Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review, 3*(3), 149-170.

Corbin, J., & Strauss, A. (2008). *Basics of qualitative research, 3rd edition*. Los Angeles, CA: Sage Publications.

Dabbish, L., & Kraut, R. (2008). Awareness displays and social motivation for coordinating communication. *Information Systems Research*, *19*(2), 221–238.

Digi. (2012). Retrieved September 11, 2011, from http://www.digi.com/xbee/

Dredge, S. (2007, December 5). *MIT's Dr Joseph Paradiso talks Smart Spaces at Nokia World 2007*. Retrieved May 1, 2012, from http://www.techdigest.tv/2007/12/mits_dr_joseph.html

Ebbinghaus, H. (1964). *Memory: A contribution to experimental psychology*. New York, NY: Dover Publications.

Enriquez, M., & MacLean, K. (2008). The role of choice in longitudinal recall of meaningful tactile signals. *Proceedings of the 2008 Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, HAPTICS '08 (pp. 49–56). Washington, DC, USA: IEEE Computer Society.

Enriquez, M., MacLean, K., & Chita, C. (2006). Haptic phonemes: basic building blocks of haptic communication. *Proceedings of the 8th international conference on Multimodal interfaces*, ICMI '06 (pp. 302–309). New York, NY, USA: ACM.

Erp, J. B., & Spapé, M. M. (2008). Time-shrinking and the design of tactons. *Proceedings of the 6th international conference on Haptics: Perception, Devices and Scenarios*, EuroHaptics '08 (pp. 289–294). Berlin, Heidelberg: Springer-Verlag.

Feige, S. (2009). Can you feel it? – Using vibration rhythms to communicate information in mobile contexts. In T. Gross, J. Gulliksen, P. Kotzé, L. Oestreicher, P. Palanque, R. O. Prates, & M. Winckler (Eds.), *Human-Computer Interaction – INTERACT 2009* (Vol. 5726, pp. 800–803). Berlin, Heidelberg: Springer-Verlag.

Fine, C. (2008). *The britannica guide to the brain*. Philadelphia, PA: Running Press.

Fry, B., & Reas, C. (2012). *Processing*. Retrieved September 1, 2011, from http://processing.org/

Good, L., & Bederson, B. B. (2002). Zoomable user interfaces as a medium for slide show presentations. *Information Visualization*, *1*(1), 35–49.

Haans, A., & IJsselsteijn, W. (2006). Mediated social touch: a review of current research and future directions. *Virtual Reality*, *9*(2), 149–159.

Hafernik, C., & Wang, J. (n.d.). *Camera phone based presentation control*. Retrieved May 1, 2012, from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.92.9320

Harrison, C., Lim, B. Y., Shick, A., & Hudson, S. E. (2009). Where to locate wearable displays?: reaction time performance of visual alerts from tip to toe. *Proceedings of the SIGCHI conference on Human factors in computing systems*, CHI '09 (pp. 941–944). New York, NY, USA: ACM.

Heikkinen, J., Rantala, J., Olsson, T., Raisamo, R., Lylykangas, J., Raisamo, J., & Surakka, V. (2009). Enhancing personal communication with spatial haptics: Two scenario-based experiments on gestural interaction. *Journal of Visual Languages and Computing*, *20*(5), 287–304.

Horvitz, E., Kadie, C., Paek, T., & Hovel, D. (2003). Models of attention in computing and communication: from principles to applications. *Communications of the ACM*, *46*(3), 52–59.

Hyun, J., Hwang, J., Ryu J., & Cho, K. (2011). Effect of spatial haptic cues on visual attention in driving. *Adjunct proceedings*, Automotive UI '11.

Iqbal, S. T., & Horvitz, E. (2007). Disruption and recovery of computing tasks: field study, analysis, and directions. *Proceedings of the SIGCHI conference on Human factors in computing systems*, CHI '07 (pp. 677–686). New York, NY, USA: ACM.

Israr, A., Tan, H. Z., & Reed, C. M. (2006). Frequency and amplitude discrimination along the kinesthetic-cutaneous continuum in the presence of masking stimuli. *The Journal of the Acoustical Society of America*, *120*(5 Pt 1), 2789–2800.

Ito, T. (2009). Preliminary study on vibrotactile messaging for sharing brief information. In J. A. Jacko (Ed.), *Human-Computer Interaction. Novel Interaction Methods and Techniques* (Vol. 5611, pp. 451–460). Berlin, Heidelberg: Springer-Verlag.

Jones, M. G., Minogue, J., Tretter, T. R., Negishi, A., & Taylor, R. (2006). Haptic augmentation of science instruction: Does touch matter? *Science Education*, *90*(1), 111–123.

Jones, S. E., & Yarbrough, A. E. (1985). A naturalistic study of the meanings of touch. *Communication Monographs*, *52*(1), 19–56.

Karuei, I., MacLean, K. E., Foley-Fisher, Z., MacKenzie, R., Koch, S., & El-Zohairy, M. (2011). Detecting vibrations across the body in mobile contexts. *Proceedings of the SIGCHI conference on Human factors in computing systems*, CHI '11 (pp. 3267–3276). New York, NY, USA: ACM.

Kazdin, A. (1982). *Single-Case Research Designs*. New York, NY: Oxford University Press.

Klatzky, R. L., Lederman, S. J., & Metzger, V. A. (1985). Identifying objects by touch: an "expert system." *Perception & Psychophysics*, *37*(4), 299–302.

Klatzky, R. L., Lederman, S. J., & Reed, C. (1987). There's more to touch than meets the eye: The salience of object attributes for haptics with and without vision. *Journal of Experimental Psychology: General*, *116*(4), 356–369.

Kurihara, K., Goto, M., Ogata, J., Matsusaka, Y., & Igarashi, T. (2007). Presentation sensei: a presentation training system using speech and image processing. *Proceedings of the 9th international conference on Multimodal interfaces*, ICMI '07 (pp. 358–365). New York, NY, USA: ACM.

Laibowitz, M., & Paradiso, J. A. (2004). The UbER-Badge, a versatile platform at the juncture between wearable and social computing. In A. Fersha, H. Hortner, & G. Kostis (Eds.), *Advances in Pervasive Computing* (pp. 363–368). Wien, Austria: Oesterreichische Computer Gesellschaft.

Lanir, J., Booth, K. S., & Tang, A. (2008). MultiPresenter: a presentation system for (very) large display surfaces. *Proceeding of the 16th ACM international conference on Multimedia*, MM '08 (pp. 519–528). New York, NY, USA: ACM.

Lazar, J., Feng, J. H., & Hochheiser, H. (2010). *Research methods in human-computer interaction.* London, UK: John Wiley and Sons Limited.

Lee, S. C., & Starner, T. (2010). BuzzWear: alert perception in wearable tactile displays on the wrist. *Proceedings of the SIGCHI conference on Human factors in computing systems*, CHI '10 (pp. 433–442). New York, NY, USA: ACM.

Leung, R., Maclean, K., Bertelsen, M., & Saubhasik, M. (2007). Evaluation of haptically augmented touchscreen gui elements under cognitive load. *Proceedings of the 9th international conference on Multimodal interfaces*, ICMI '07 (pp. 374–381). New York, NY, USA: ACM.

Lindeman, R. W., Page, R., Yanagida, Y., & Sibert, J. L. (2004). Towards full-body haptic feedback: the design and deployment of a spatialized vibrotactile feedback system. *Proceedings of the ACM symposium on Virtual reality software and technology*, VRST '04 (pp. 146–149). New York, NY, USA: ACM.

Logitech. (2012). Retrieved May 1, 2012, from http://www.logitech.com/en-ca/remotes

Luk, J., Pasquero, J., Little, S., MacLean, K., Levesque, V., & Hayward, V. (2006). A role for haptics in mobile interaction: initial design using a handheld tactile display prototype. *Proceedings of the SIGCHI*

conference on Human Factors in computing systems, CHI '06 (pp. 171–180). New York, NY, USA: ACM.

MacLean, K. E. (2008). Foundations of transparency in tactile information design. *IEEE Transactions on Haptics*, *1*(2), 84 –95.

MacLean, K. E. (2009). Putting haptics into the ambience. *IEEE Transactions on Haptics*, *2*(3), 123–135.

Maclean, K. E., & Enriquez, M. (2003). Perceptual design of haptic icons. *In Proceedings of Eurohaptics* (pp. 351–363). Dublin, Ireland.

Mamykina, L., Mynatt, E., & Terry, M. A. (2001). Time Aura: interfaces for pacing. *Proceedings of the SIGCHI conference on Human factors in computing systems*, CHI '01 (pp. 144–151). New York, NY, USA: ACM.

Mastin, L. (2010). *The human memory*. Retrieved May 1, 2012, from http://www.human-memory.net

Matlin, M. W. (2005). *Cognition*. Crawfordsville, IN: John Wiley and Sons Limited.

McLeod, S. (2007). *Study of memory in psychology*. Retrieved May 1, 2012, from http://www.simplypsychology.org/memory.html

Microsoft PowerPoint. (2012). Retrieved May 1, 2012, from http://office.microsoft.com/en-ca/powerpoint/

Moreno, R., & Mayer, R. (1999). Cognitive principles of multimedia learning: The role of modality and contiguity. *Journal of Educational Psychology*, *91*(2), 358–368.

Mutewatch. (2012). Retrieved October 31, 2011, from http://mutewatch.com/

Myers, B. A. (2000). Using multiple devices simultaneously for display and control. *IEEE Personal Communications*, *7*(5), 62 –65.

Oakley, I., & Park, J. (2008). Did you feel something? Distracter tasks and the recognition of vibrotactile cues. *Interacting with Computers*, *20*(3), 354–363.

Occhialini, V., van Essen, H., & Eggen, B. (2011). Design and evaluation of an ambient display to support time management during meetings. *Proceedings of the 13th IFIP TC 13 international conference on Human-computer interaction - Volume Part II*, INTERACT'11 (pp. 263–280). Berlin, Heidelberg: Springer-Verlag.

Okada, T., Yamamoto, T., Terada, T., & Tsukamoto, M. (2011). Wearable MC system a system for supporting MC performances using wearable computing technologies. *Proceedings of the 2nd Augmented Human International Conference*, AH '11 (pp. 25:1–25:7). New York, NY, USA: ACM.

Oulasvirta, A., Tamminen, S., Roto, V., & Kuorelahti, J. (2005). Interaction in 4-second bursts: the fragmented nature of attentional resources in mobile HCI. *Proceedings of the SIGCHI conference on Human factors in computing systems*, CHI '05 (pp. 919–928). New York, NY, USA: ACM.

Oviatt, S., Coulston, R., & Lunsford, R. (2004). When do we interact multimodally?: cognitive load and multimodal communication patterns. *Proceedings of the 6th international conference on Multimodal interfaces*, ICMI '04 (pp. 129–136). New York, NY, USA: ACM.

Paivio, A. (1971). *Imagery and verbal processes*. New York: Holt, Rinehart and Winston.

Paivio, A. (1986). *Mental representations: a dual coding approach*. New York: Oxford University Press.

Pakkanen, T., Lylykangas, J., Raisamo, J., Raisamo, R., Salminen, K., Rantala, J., & Surakka, V. (2008). Perception of low-amplitude haptic stimuli when biking. *Proceedings of the 10th international conference on Multimodal interfaces*, ICMI '08 (pp. 281–284). New York, NY, USA: ACM.

Post, L. J., Zompa, I. C., & Chapman, C. E. (1994). Perception of vibrotactile stimuli during motor activity in human subjects. *Experimental Brain Research*, *100*(1), 107–120.

Predebon, J. (1999). Time judgments as a function of clock duration: Effects of temporal paradigm and an attention-demanding nontemporal task. *Perceptual and Motor Skills*, *88*(3c), 1251–1254.

Qian, H., Kuber, R., & Sears, A. (2009). Towards identifying distinguishable tactons for use with mobile devices. *Proceedings of the 11th international ACM SIGACCESS conference on Computers and accessibility*, Assets '09 (pp. 257–258). New York, NY, USA: ACM.

Robinett, M. I. (2002, January 31). *Timing device with silent vibrating alarm*. Retrieved August 10, 2011, from http://www.freepatentsonline.com/y2002/0012291.html

Spence, C., McDonald, J., & Driver, J. (2004). Exogenous spatial cuing studies of human crossmodal attention and multisensory integration (Chap. 11). In C. Spence, & J. Driver (Eds.), *Crossmodal Space and Crossmodal Attention* (pp. 277). Oxford, England: Oxford University Press.

Sperling, G. (1960). The information available in brief visual presentations. *Psychological Monographs, 74*, 1–29.

Spicer, R. P., & Kelliher, A. (2009). NextSlidePlease: navigation and time management for hyperpresentations. *Proceedings of the 27th international conference extended abstracts on Human factors in computing systems*, CHI EA '09 (pp. 3883–3888). New York, NY, USA: ACM.

Spicer, R. P., Lin, Y. R., & Kelliher, A. (2009). NextSlidePlease: agile hyperpresentations. *Proceedings of the 17th ACM international conference on Multimedia*, MM '09 (pp. 1045–1048). New York, NY, USA: ACM.

Spicer, R. P., Lin, Y. R., Kelliher, A., & Sundaram, H. (2009). A slide-ware application to support discursive presentations. *Proceedings of the 17th ACM international conference on Multimedia*, MM '09 (pp. 971–972). New York, NY, USA: ACM.

Stake, R. E. (1995). *The Art of Case Study Research.* Thousand Oaks, CA: Sage Publications.

Stanley, A. A., & Kuchenbecker, K. J. (2012). Evaluation of tactile feedback methods for wrist rotation guidance. *IEEE Transactions on Haptics 5*, 3, 240 –251.

Sternberg, R. J. (1999). *Cognitive psychology (2nd ed.)*. Fort Worth, TX: Harcourt Brace College Publishers.

Swerdfeger, B. A., Fernquist, J., Hazelton, T. W., & MacLean, K. E. (2009). Exploring melodic variance in rhythmic haptic stimulus design. *Proceedings of Graphics Interface 2009*, GI '09 (pp. 133–140). Toronto, Ont., Canada: Canadian Information Processing Society.

Tang, A., McLachlan, P., Lowe, K., Saka, C. R., & MacLean, K. (2005). Perceiving ordinal data haptically under workload. *Proceedings of the 7th international conference on Multimodal interfaces*, ICMI '05 (pp. 317–324). New York, NY, USA: ACM.

Ternes, D., & Maclean, K. E. (2008). Designing large sets of haptic icons with rhythm. *Proceedings of the 6th international conference on Haptics: Perception, Devices and Scenarios*, EuroHaptics '08 (pp. 199–208). Berlin, Heidelberg: Springer-Verlag.

Töyssy, S., Raisamo, J., & Raisamo, R. (2008). Telling time by vibration. *Proceedings of the 6th international conference on Haptics: Perception, Devices and Scenarios*, EuroHaptics '08 (pp. 924–929). Berlin, Heidelberg: Springer-Verlag.

Tsukada, K., & Yasumura, M. (2004). ActiveBelt: Belt-type wearable tactile display for directional navigation. In N. Davies, E. D. Mynatt, & I. Siio (Eds.), *UbiComp 2004 LNCS* (Vol. 3205, pp. 384-399). Berlin, Heidelberg: Springer-Verlag.

van Erp, J., & Spapé, M. (2003). Distilling the underlying dimensions of tactile melodies. *Proceedings of Eurohaptics 2003* (pp. 111–120). Dublin, Ireland.

Visell, Y. (2009). Tactile sensory substitution: Models for enaction in HCI. *Interacting with Computers*, *21*(1-2), 38–53.

Wickens, C. D. (1984). Processing resources in attention. In R. Parasuraman, & D. R. Davies (Eds.), *Varieties of attention* (pp. 63–102). New York, NY: Academic Press.

Wickens, D. D. (1972). Characteristics of word encoding. In A. W. Melton, & E. Martin (Eds.), *Coding processes in human memory* (pp. 191–215). Washington, DC: Winston and Sons.

Appendix A

Recruitment Emails

A.1 Haptics Symposium Speaker (Pre-Study)

Subject line: HS 2012: Requesting study participation by HS speakers

Dear <name>,

You are receiving this request because we understand that you (or a co-author) will be giving an oral presentation at Haptics Symposium 2012 (HS 2012). The HS 2012 organizing committee has given us permission to contact you in this capacity.

Not the presenter? If you are **NOT** the one presenting at HS 2012, please respond to this email with the **name and email address** of the **co-author** who **WILL** be presenting at the conference. We would like to invite them to participate in the study highlighted below.

Study title: Exploring Presentation Timing Through Haptic Reminders

Invitation: We invite you to participate in a study being conducted at HS 2012. The study will evaluate a novel prototype that provides haptic reminders to a speaker during a conference presentation as a means of helping the speaker deliver a timely presentation.

If you would like to proceed to Part 1 of the study (highlighted below), and/or to learn more about the study, please access the pre-study questionnaire at:
<URL goes here>

Goal of study: To understand how conference speakers and session chairs experience haptic reminders, and how they could be improved for presentation use.

Team: Diane Tam (MSc student), Dr. Karon MacLean and Dr. Joanna McGrenere, University of British Columbia; Dr. Katherine J. Kuchenbecker, University of Pennsylvania.

What are we asking of you? The full study has three parts. *Completing any part does not obligate your further participation. You may withdraw from the study at any time.*

1) **Pre-Study Questionnaire** (approx. 10 min) – This questionnaire will gather background information necessary for our study and inform us of your interest and willingness to participate in our study at HS 2012 (Parts 2 and 3 below).
2) **HS 2012 Oral Presentation** (10-15 min) – If you agree to participate in Part 2, you will wear a haptic reminder device while giving your oral presentation at HS 2012. This device is able to deliver haptic reminders to you and the session chairs to help keep the presentations on time.
3) **Post-Study Questionnaire** (approx. 10 min) - After your paper session, you will be invited to complete a post-questionnaire about your presentation experience.

Again, for your convenience, the pre-study questionnaire (Part 1) can be accessed at: <URL goes here>

The pre-study questionnaire (Part 1) needs to be completed by **<date>** for us to utilize your participation in Part 2, but ideally **as soon as possible** to help us plan.

Please feel free to contact me if you have any questions or concerns regarding the study.

Thank you for your time!
<Researcher contact info goes here>

This study has been approved by the University of British Columbia's Behavioral Ethics Board, # H11-03432. If you have any concerns, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

A.2 Haptics Symposium Session Chair (Pre-Study)

Subject line: HS 2012: Requesting participation by HS session chairs in study

Dear <name>,

You are receiving this request because we understand that you will be chairing a paper session at Haptics Symposium 2012 (HS 2012). The HS 2012 organizing committee has given us permission to contact you in this capacity

Study title: Exploring Presentation Timing Through Haptic Reminders

Invitation: We invite you to participate in a study being conducted at HS 2012. The study will evaluate a novel prototype that provides haptic reminders to a speaker during a conference presentation as a means of helping the speaker deliver a timely presentation.

If you would like to proceed to Part 1 of the study (highlighted below), and/or to learn more about the study, please access the pre-study questionnaire at:
<URL goes here>

Goal of study: To understand how conference speakers and session chairs experience haptic reminders, and how they could be improved for presentation use.

Team: Diane Tam (MSc student), Dr. Karon MacLean and Dr. Joanna McGrenere, University of British Columbia; Dr. Katherine J. Kuchenbecker, University of Pennsylvania.

What are we asking of you? The full study has three parts. *Completing any part does not obligate your further participation. You may withdraw from the study at any time.*

1) **Pre-Study Questionnaire** (approx. 10 min) – This questionnaire will gather background information necessary for our study and inform us of your interest and willingness to participate in our study at HS 2012 (Parts 2 and 3 below).
2) **HS 2012 Paper Session** (60-90 min) – If you agree to participate in Part 2, you will wear a haptic reminder device while chairing a paper session at HS 2012. This device is able to deliver haptic reminders to you and the speakers to help keep the presentations on time.
3) **Post-Study Questionnaire** (approx. 10 min) – After your paper session, you will be invited to complete a post-questionnaire about your session experience.

Again, for your convenience, the pre-study questionnaire (Part 1) can be accessed at:
<URL goes here>

The pre-study questionnaire (Part 1) needs to be completed by **<date>** for us to utilize your participation in Part 2, but ideally **as soon as possible** to help us plan.

Please feel free to contact me if you have any questions or concerns regarding the study.

Thank you for your time!
<Researcher contact info goes here>

This study has been approved by the University of British Columbia's Behavioral Ethics Board, # H11-03432. If you have any concerns, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

A.3 Haptics Symposium Audience (Post-Study)

Subject line: HS 2012: Requesting conference feedback from HS attendees

Dear <name>,

You are receiving this request because we understand that you attended Haptics Symposium (HS 2012). The HS 2012 organizing committee has given us permission to contact you in this capacity.

Study title: Exploring Presentation Timing Through Haptic Reminders

Invitation: We invite you to complete a brief questionnaire (3-5 minutes) as part of a study that was conducted at HS 2012. The study evaluated a novel prototype that provides haptic reminders to a speaker during a conference presentation as a means of helping the speaker deliver a timely presentation, and this survey collects your own impressions of the presentation reminders and timing at the conference.

Survey: <link>
Completion needed by: **<date>**

Goal of study: To understand how conference speakers, session chairs, and audience members experience haptic reminders, and how they could be improved for presentation use.

Team: Diane Tam (MSc student), Dr. Karon MacLean and Dr. Joanna McGrenere, University of British Columbia; Dr. Katherine J. Kuchenbecker, University of Pennsylvania.

Please feel free to contact me if you have any questions or concerns regarding the study.

Thank you for your time!

<Researcher contact info goes here>

This study has been approved by the University of British Columbia's Behavioral Ethics Board, # H11-03432. If you have any concerns, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

A.4 Class Lecture (Pre-Study)

Subject line: Haptic Reminders Study - Requesting study participation by UBC lecturers

Dear <name>,

You are receiving this email because we believe you have shown interest in exploring the use of haptic reminders while lecturing a class at the University of British Columbia (UBC).

Invitation: This email invites you to participate in a study being conducted at UBC. The study will evaluate a novel prototype that provides haptic reminders to a lecturer as a means of helping him/her teach a class in a timely manner.

> If you would like to proceed to Part 1 of the study (highlighted below), and/or to learn more about the study, please access the pre-study questionnaire <link>.

Goal of study: To understand how university lecturers experience haptic reminders, and how they could be improved for class lecture use.

Team: Diane Tam (MSc student), Dr. Karon MacLean and Dr. Joanna McGrenere, University of British Columbia; Dr. Katherine J. Kuchenbecker, University of Pennsylvania.

What are we asking of you? The full study has four parts. Completing any part does not obligate your further participation. You may withdraw from the study at any time.

1) **Pre-Study Questionnaire (approx. 10 min)** – This questionnaire will gather background information necessary for our study and inform us of your interest and willingness to participate in our study (Parts 2, 3, and 4 below).
2) **Main Study – Class Lectures (approx. 4-8 lectures)** – If you agree to participate in Part 2, you will be studied across approximately 4-8 lectures with the goal of comparing your experience of teaching lectures with and without haptic reminders. For the lectures with haptic reminders, you will wear a watch-like device that delivers discreet vibrations at specific time intervals during the lecture.
3) **Post-Study Questionnaire (approx. 10 min)** - After each lecture, you will be invited to complete a post-questionnaire about your lecture experience.
4) **Post-Interview (approx. 15 min)** – After all the sessions are complete, there will be a brief interview session to further learn of your lecturing experience with and without haptic reminders.

Please feel free to contact me if you have any questions or concerns regarding the study.

Thank you for your time!

<Researcher contact info goes here>

This study has been approved by the University of British Columbia's Behavioral Ethics Board, # H11-03432. If you have any concerns, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Appendix B

Consent Forms

B.1 Haptics Symposium Speaker (Pre-Study)

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science
2366 Main Mall
Vancouver, B.C., V6T 1Z4
Canada

Exploring Presentation Timing Through Haptic Reminders

Pre-Study Questionnaire

Consent Form for SPEAKER

Principal Investigators
Dr. Karon MacLean, Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Joanna McGrenere, Associate Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Katherine J. Kuchenbecker, Assistant Professor, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, xxx-xxx-xxxx.

Co-Investigators
Diane Tam, MSc student, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Study Purpose
The purpose of this study is to explore better timing solutions for conference presentations, as current time reminders (e.g., clock, session chair warnings) are often missed, disruptive, or require frequent self-monitoring.

We will be evaluating how and to what degree haptic reminders <link to haptic reminder device description here> may have value in improving the timing experience and outcome of presentations for speakers, session chairs, and audience members. This will lend insight into the diversity of how haptic reminders may be perceived, and further inform design implications most suited for conference presentations.

Procedure
The full study has three parts, of which this pre-study questionnaire is the first. Completing any part does not obligate your further participation. You may withdraw from the study at any time.

> **1) Pre-Study Questionnaire (approximately 10 minutes) —** This questionnaire will gather background information necessary for our study and inform us of your interest and willingness to participate in our study at HS 2012 (Parts 2 and 3 below). This needs to be completed prior to your oral presentation for us to utilize your participation in Part 2, but ideally as soon as possible to help us plan.
>
> **2) Main Study — 2012 IEEE Haptics Symposium Oral Presentation (10-60 minutes) —** If you agree to participate in Part 2, you will wear a watch-like haptic reminder device while giving your oral presentation at HS 2012. This device is able to deliver haptic reminders in the form of discreet vibrations to you and the session chairs to help keep the presentations on time. The reminders will be

delivered at specific time intervals, which will depend on the length of your oral presentation, and serve to remind you of the time remaining.

Upon receipt of a reminder, you may acknowledge it through a subtle gesture with the device. This acknowledgement will reassure your session chairs, who will be receiving the same haptic reminders as you on their own devices, that you are aware of the time remaining. Your presentation will be video recorded, with post-hoc observation of the usage patterns for this haptic reminder device.

Optionally, if you wish to participate but do not wish to wear the haptic reminder device, you can choose to opt out of the haptic reminders. In this case, you will receive the standard conference time reminders from the session chairs (e.g., paper signs indicating the time remaining).

3) Post-Study Questionnaire (approximately 10 minutes) — After your paper session, you will be invited to complete a post-questionnaire about your presentation experience. You will be given a paper document with instructions and a link to this questionnaire, which is to be completed as soon as possible after your paper session, at either a designated laptop station at the conference or another machine of your choice. The questionnaire will close a week after the conference ends, but you are strongly encouraged to complete it very soon after your paper session for a more accurate recollection of your experience.

Potential Risks and Benefits
There are no known risks or benefits to completing this questionnaire. However, your participation in this questionnaire will be tremendously valuable to our continued research efforts in improving the timeliness of presentations for speakers and session chairs.

Confidentiality
All data collected from the questionnaire will be kept confidential. Your contact information will be used only by the experimenter as a means for contacting you with instructions regarding the study. All data will be stored securely in a locked metal filing cabinet or in a password-protected computer account accessible only to the experimenter. All data will also be coded so that your anonymity will be protected in any reports, research papers, thesis documents, and presentations on this work.

Contact for information about the study
Please contact Diane Tam (phone: xxx-xxx-xxxx / email: <email address>) if you require assistance with the completion of the questionnaire or have questions about the study.

Contact for information about the rights of research subjects
If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Consent
We intend for your participation in this project to be pleasant and stress-free. Your participation is entirely voluntary and you may refuse to participate or withdraw from the study at any time.

Your consent to participate in this pre-study questionnaire (Part 1) will be assumed upon its completion and submission.

B.2 Haptics Symposium Speaker (Main and Post-Study)

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science
2366 Main Mall
Vancouver, B.C., V6T 1Z4
Canada

Exploring Presentation Timing Through Haptic Reminders

Main and Post-Study Questionnaire

Consent Form for SPEAKER

Principal Investigators
Dr. Karon MacLean, Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Joanna McGrenere, Associate Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Katherine J. Kuchenbecker, Assistant Professor, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, xxx-xxx-xxxx.

Co-Investigators
Diane Tam, MSc student, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Study Purpose
The purpose of this study is to explore better timing solutions for conference presentations, as current time reminders (e.g., clock, session chair warnings) are often missed, disruptive, or require frequent self-monitoring.

We will be evaluating how and to what degree haptic reminders <link to haptic reminder device description here> may have value in improving the timing experience and outcome of presentations for speakers, session chairs, and audience members. This will lend insight into the diversity of how haptic reminders may be perceived, and further inform design implications most suited for conference presentations.

Procedure

1) Pre-Study Questionnaire (approximately 10 minutes) — This questionnaire will gather background information necessary for our study and inform us of your interest and willingness to participate in our study at HS 2012 (Parts 2 and 3 below). This needs to be completed prior to your oral presentation for us to utilize your participation in Part 2, but ideally as soon as possible to help us plan.

2) Main Study — 2012 IEEE Haptics Symposium Oral Presentation (10-15 minutes) — If you agree to participate in Part 2, you will wear a watch-like haptic reminder device while giving your oral presentation at HS 2012. This device is able to deliver haptic reminders in the form of discreet vibrations to you and the session chairs to help keep the presentations on time. The reminders will be delivered at specific time intervals, which will depend on the length of your oral presentation, and serve to remind you of the time remaining.

Upon receipt of a reminder, you may acknowledge it through a subtle gesture with the device. This acknowledgement will reassure your session chairs, who will be receiving the same haptic reminders as you on their own devices, that you are aware of the time remaining. Your presentation will be video recorded, with post-hoc observation of the usage patterns for this haptic reminder device.

Optionally, if you wish to participate but do not wish to wear the haptic reminder device, you can choose to opt out of the haptic reminders. In this case, you will receive the standard conference time reminders from the session chairs (e.g., paper signs indicating the time remaining).

3) Post-Study Questionnaire (approximately 10 minutes) — After your paper session, you will be invited to complete a post-questionnaire about your presentation experience. You will be given a paper document with instructions and a link to this questionnaire, which is to be completed as soon as possible after your paper session, at either a designated laptop station at the conference or another machine of your choice. The questionnaire will close a week after the conference ends, but you are strongly encouraged to complete it very soon after your paper session for a more accurate recollection of your experience.

Preparation

1) Prior to HS 2012 — By a week or more before the conference starts, you will receive an email with full instructions regarding how and where to proceed at the conference.

2) Demo at HS2012 (5-10 minutes) — You will also have various opportunities at the conference prior to your presentation to become familiarized and comfortable with the haptic reminder device. You will be fully informed on how to wear the device, when you will receive the reminders, what the reminders will feel like, and how to acknowledge them if needed. An experimenter or assistant to the study will be available to answer any questions you have about the instructions or procedures of this study anytime before, during, and after the conference.

Potential Risks

There are no known risks to your participation in this study.

Confidentiality

All data collected from the questionnaires and video recordings will be kept confidential. Your contact information will be used only by the experimenter as a means for contacting you with instructions regarding the study. All data will be stored securely in a locked metal filing cabinet or in a password-protected computer account accessible only to the experimenter. All data will also be coded so that your anonymity will be protected in any reports, research papers, thesis documents, and presentations on this work.

Benefits

You will have the opportunity to benefit from a private haptic time reminder system at a conference session you present at. The system may potentially alleviate the manual task of time checking and visual distractions of standard session chair reminders, while helping you deliver a timely presentation.

Your participation will also help inform further design implications that may improve the quality and timeliness of future conference presentation sessions.

Compensation

You will be compensated with a small gift of value $10, such as a Starbucks' gift card, for your participation in the study.

Contact for information about the study

Please contact Diane Tam (phone: xxx-xxx-xxxx / email: <email address>) if you require assistance with the completion of the questionnaire or have questions about the study.

Contact for information about the rights of research subjects
If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Consent
We intend for your participation in this project to be pleasant and stress-free. Your participation is entirely voluntary and you may refuse to participate or withdraw from the study at any time, including just before or during your talk itself; for example, you may signal to the session chair to turn off the device and revert to standard timing signals if you become uncomfortable.

Your full consent will be requested during a demo session AT the conference prior to your oral presentation, and be required in order for your participation to continue.

Participation
In order to expedite the consent process for your participation at the conference, we have walked you through the consent document provided here, and now ask you to indicate the study variant to which you plan to consent. YOUR CONSENT WILL NOT BE ASSUMED UNTIL YOU HAVE SIGNED, DATED AND RETURNED THIS FORM.

If you choose to change your decision of consent, you may do so at anytime by contacting the experimenter.

I have read the study details above, and am consenting to:

Haptic Reminder Device:

- ☐ WEARING the haptic reminder device during my presentation.
- ☐ NOT WEARING the haptic reminder device during my presentation.

Video Recording:

- ☐ BEING VIDEO RECORDED during my presentation.
- ☐ NOT BEING VIDEO RECORDED during my presentation.

Post-Questionnaire:

- ☐ COMPLETING the post-questionnaire following my presentation.
- ☐ NOT COMPLETING the post-questionnaire following my presentation.

I hereby CONSENT to participate in this study and acknowledge RECEIPT of a copy of the consent form:

NAME _____ DATE _____
(please print)

SIGNATURE _____

B.3 Haptics Symposium Session Chair (Pre-Study)

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science
2366 Main Mall
Vancouver, B.C., V6T 1Z4
Canada

Exploring Presentation Timing Through Haptic Reminders

Pre-Study Questionnaire

Consent Form for SESSION CHAIR

Principal Investigators
Dr. Karon MacLean, Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Joanna McGrenere, Associate Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Katherine J. Kuchenbecker, Assistant Professor, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, xxx-xxx-xxxx.

Co-Investigators
Diane Tam, MSc student, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Study Purpose
The purpose of this study is to explore better timing solutions for conference presentations. Current time reminders for speakers and the time-scheduling tasks of session chairs are often missed, disruptive, or require frequent self-monitoring.

We will be evaluating how and to what degree haptic reminders <link to haptic reminder device description here> may have value in improving the timing experience and outcome of presentations for speakers, session chairs, and audience members. This will lend insight into the diversity of how haptic reminders may be perceived, and further inform design implications most suited for conference presentations.

Procedure
The full study has three parts, of which this pre-study questionnaire is the first. Completing any part does not obligate your further participation. You may withdraw from the study at any time.

> **1) Pre-Study Questionnaire (approximately 10 minutes) —** This questionnaire will gather background information necessary for our study and inform us of your interest and willingness to participate in our study at HS 2012 (Parts 2 and 3 below). This needs to be completed prior to your paper session for us to utilize your participation in Part 2, but ideally as soon as possible to help us plan.
>
> **2) Main Study — 2012 IEEE Haptics Symposium Paper Session (60-90 minutes)** — If you agree to participate in Part 2, you will wear a watch-like haptic reminder device while chairing a paper session at HS 2012. This device is able to deliver haptic reminders in the form of discreet vibrations to

you and the speakers to help keep the presentations on time. The reminders will be delivered at specific time intervals during the presentations, and serve to remind you of the speaker's time remaining.

If the speaker is also a participant in the study, he/she will be receiving the same haptic reminders as you on his/her own device, and may be required to acknowledge the reminder upon its receipt. This acknowledgement will reassure you that the speaker is aware of the time remaining. If the speaker is not a participant in the study, you will simply deliver the standard conference time reminders (e.g., holding up a paper sign) to that speaker, but will use the haptic device YOURSELF to help you in your time mediating duties. You will be video recorded throughout your session, with post-hoc observation of the usage patterns for this haptic reminder device.

Optionally, if you wish to participate but do not wish to wear the haptic reminder device, you can choose to opt out of the haptic reminders. In this case, you will deliver the standard conference time reminders to speakers during your chairing duties.

3) Post-Study Questionnaire (approximately 10 minutes) — After your paper session, you will be invited to complete a post-questionnaire about your session experience. You will be given a paper document with instructions and a link to this questionnaire, which is to be completed as soon as possible after your paper session, at either a designated laptop station at the conference or another machine of your choice. The questionnaire will close a week after the conference ends, but you are strongly encouraged to complete it very soon after your paper session for a more accurate recollection of your experience.

Potential Risks and Benefits
There are no known risks or benefits to completing this questionnaire. However, your participation in this questionnaire will be tremendously valuable to our continued research efforts in improving the timeliness of presentations for speakers and session chairs.

Confidentiality
All data collected from the questionnaire will be kept confidential. Your contact information will be used only by the experimenter as a means for contacting you with instructions regarding the study. All data will be stored securely in a locked metal filing cabinet or in a password-protected computer account accessible only to the experimenter. All data will also be coded so that your anonymity will be protected in any reports, research papers, thesis documents, and presentations on this work.

Contact for information about the study
Please contact Diane Tam (phone: xxx-xxx-xxxx / email: <email address>) if you require assistance with the completion of the questionnaire or have questions about the study.

Contact for information about the rights of research subjects
If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Consent
We intend for your participation in this project to be pleasant and stress-free. Your participation is entirely voluntary and you may refuse to participate or withdraw from the study at any time.

Your consent to participate in this pre-study questionnaire (Part 1) will be assumed upon its completion and submission.

B.4 Haptics Symposium Session Chair (Main and Post-Study)

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science
2366 Main Mall
Vancouver, B.C., V6T 1Z4
Canada

Exploring Presentation Timing Through Haptic Reminders

Main and Post-Study Questionnaire

Consent Form for SESSION CHAIR

Principal Investigators
Dr. Karon MacLean, Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Joanna McGrenere, Associate Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Katherine J. Kuchenbecker, Assistant Professor, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, xxx-xxx-xxxx.

Co-Investigators
Diane Tam, MSc student, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Study Purpose
The purpose of this study is to explore better timing solutions for conference presentations. Current time reminders for speakers and the time-scheduling tasks of session chairs are often missed, disruptive, or require frequent self-monitoring.

We will be evaluating how and to what degree haptic reminders <link to haptic reminder device description here> may have value in improving the timing experience and outcome of presentations for speakers, session chairs, and audience members. This will lend insight into the diversity of how haptic reminders may be perceived, and further inform design implications most suited for conference presentations.

Procedure

1) Pre-Study Questionnaire (approximately 10 minutes) — This questionnaire will gather background information necessary for our study and inform us of your interest and willingness to participate in our study at HS 2012 (Parts 2 and 3 below). This needs to be completed prior to your paper session for us to utilize your participation in Part 2, but ideally as soon as possible to help us plan.

2) Main Study — 2012 IEEE Haptics Symposium Paper Session (60-90 minutes) — If you agree to participate in Part 2, you will wear a watch-like haptic reminder device while chairing a paper session at HS 2012. This device is able to deliver haptic reminders in the form of discreet vibrations to you and the speakers to help keep the presentations on time. The reminders will be delivered at specific time intervals during the presentations, and serve to remind you of the speaker's time remaining.

If the speaker is also a participant in the study, he/she will be receiving the same haptic reminders as you on his/her own device, and may be required to acknowledge the reminder upon its receipt. This acknowledgement will reassure you that the speaker is aware of the time remaining. If the speaker is not a participant in the study, you will simply deliver the standard conference time reminders (e.g., holding up a paper sign) to that speaker, but will use the haptic device YOURSELF to help you in your time mediating duties. You will be video recorded throughout your session, with post-hoc observation of the usage patterns for this haptic reminder device.

Optionally, if you wish to participate but do not wish to wear the haptic reminder device, you can choose to opt out of the haptic reminders. In this case, you will deliver the standard conference time reminders to speakers during your chairing duties.

3) Post-Study Questionnaire (approximately 10 minutes) — After your paper session, you will be invited to complete a post-questionnaire about your session experience. You will be given a paper document with instructions and a link to this questionnaire, which is to be completed as soon as possible after your paper session, at either a designated laptop station at the conference or another machine of your choice. The questionnaire will close a week after the conference ends, but you are strongly encouraged to complete it very soon after your paper session for a more accurate recollection of your experience.

Preparation

1) Prior to HS 2012 — By a week or more before the conference starts, you will receive an email with full instructions regarding how and where to proceed at the conference.

2) Demo at HS2012 (5-10 minutes) — You will also have various opportunities at the conference prior to your paper session to become familiarized and comfortable with the haptic reminder device. You will be fully informed on how to wear the device, when you will receive the reminders, and what the reminders will feel like. Additionally, a small set of simple chairing controls will be demonstrated to you for use during the session. An experimenter or assistant to the study will be available to answer any questions you have about the instructions or procedures of this study anytime before, during, and after the conference.

Potential Risks

There are no known risks to your participation in this study.

Confidentiality

All data collected from the questionnaires and video recordings will be kept confidential. Your contact information will be used only by the experimenter as a means for contacting you with instructions regarding the study. All data will be stored securely in a locked metal filing cabinet or in a password-protected computer account accessible only to the experimenter. All data will also be coded so that your anonymity will be protected in any reports, research papers, thesis documents, and presentations on this work.

Benefits

You will have the opportunity to benefit from a privately automated speaker reminder system at a conference session you chair. The system may potentially alleviate the manual tasks of time checking and issuing time warnings to speakers, allowing you to focus on the presentations instead.

Your participation will also help inform further design implications that may improve the quality and timeliness of future conference presentation sessions.

Compensation

You will be compensated with a small gift of value $10, such as a Starbucks' gift card, for your participation in the study.

Contact for information about the study
Please contact Diane Tam (phone: xxx-xxx-xxxx / email: <email address>) if you require assistance with the completion of the questionnaire or have questions about the study.

Contact for information about the rights of research subjects
If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Consent
We intend for your participation in this project to be pleasant and stress-free. Your participation is entirely voluntary and you may refuse to participate or withdraw from the study at any time.

Your full consent will be requested during a demo session AT the conference prior to your paper session, and be required in order for your participation to continue.

Participation
In order to expedite the consent process for your participation at the conference, we have walked you through the consent document provided here, and now ask you to indicate the study variant to which you plan to consent. YOUR CONSENT WILL NOT BE ASSUMED UNTIL YOU HAVE SIGNED, DATED, AND RETURNED THIS FORM.

If you choose to change your decision of consent, you may do so at anytime by contacting the experimenter.

I have read the study details above, and am consenting to:

Haptic Reminder Device:

- ☐ WEARING the haptic reminder device during the paper sessions I will be chairing.
- ☐ NOT WEARING the haptic reminder device during the paper sessions I will be chairing.

Video Recording:

- ☐ BEING VIDEO RECORDED during the paper sessions I will be chairing.
- ☐ NOT BEING VIDEO RECORDED during the paper sessions I will be chairing.

Post-Questionnaire:

- ☐ COMPLETING the post-questionnaire following the paper sessions I will be chairing.
- ☐ NOT COMPLETING the post-questionnaire following the paper sessions I will be chairing.

I hereby CONSENT to participate in this study and acknowledge RECEIPT of a copy of the consent form:

NAME _____ DATE _____
(please print)
SIGNATURE _____

B.5 Haptics Symposium Audience (Post-Study)

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science
2366 Main Mall
Vancouver, B.C., V6T 1Z4
Canada

Exploring Presentation Timing Through Haptic Reminders

Post-Conference Questionnaire

Consent Form for AUDIENCE

Principal Investigators
Dr. Karon MacLean, Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Joanna McGrenere, Associate Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Katherine J. Kuchenbecker, Assistant Professor, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, xxx-xxx-xxxx.

Co-Investigators
Diane Tam, MSc student, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Study Purpose
The purpose of this study is to explore better timing solutions for conference presentations as current time reminders (e.g., clock, session chair warnings) are often missed, disruptive, or require frequent self-monitoring.

We will be evaluating how and to what degree haptic reminders <link to haptic reminder device description here> may have value in improving the timing experience and outcome of presentations for speakers, session chairs, and audience members. This will lend insight into the diversity of how haptic reminders may be perceived, and further inform design implications most suited for conference presentations.

Procedure
This brief (3-5 minutes) questionnaire will gather your overall conference experience with presentation reminders and timing at HS 2012. Please complete this by **<date>** in order for us to utilize your feedback in our study.

Potential Risks and Benefits
There are no known risks or benefits to completing this questionnaire. However, your participation in this questionnaire will be tremendously valuable to our continued research efforts in improving the timeliness of presentations for speakers, session chairs, and audience members.

Confidentiality
The identities of all people who complete the questionnaire will remain anonymous and all data will be kept confidential. You do not have to provide your name or contact information. All data will be stored securely in a locked metal filing cabinet or in a password-protected computer account accessible only to the experimenter.

All data will also be coded so that your anonymity will be protected in any reports, research papers, thesis documents, and presentations on this work.

Contact for information about the study
Please contact Diane Tam (phone: xxx-xxx-xxxx / email: <email address>) if you require assistance with the completion of the questionnaire or have questions about the study.

Contact for information about the rights of research subjects
If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Consent
We intend for your participation in this project to be pleasant and stress-free. Your participation is entirely voluntary and you may refuse to participate or withdraw from the study at any time.

Your consent to participate in this questionnaire will be assumed upon its completion and submission.

B.6 Class Lecture (Pre-Study)

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science
2366 Main Mall
Vancouver, B.C., V6T 1Z4
Canada

Exploring Presentation Timing Through Haptic Reminders

Pre-Study Questionnaire

Consent Form for LECTURER

Principal Investigators
Dr. Karon MacLean, Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Joanna McGrenere, Associate Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Katherine J. Kuchenbecker, Assistant Professor, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, xxx-xxx-xxxx.

Co-Investigators
Diane Tam, MSc student, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Study Purpose
We will be evaluating how and to what degree haptic reminders <link to haptic reminder device description here> may have value to a lecturer as a means of helping him/her teach a class in a timely manner. This will lend insight into how haptic reminders may be perceived, and further inform design implications most suited for class lecture use.

Procedure
The full study has four parts, of which this pre-study questionnaire is the first. Completing any part does not obligate your further participation. You may withdraw from the study at any time.

1) **Pre-Study Questionnaire (approximately 10 minutes)** – This online questionnaire will gather background information with regards to personal lecturing and timing experiences necessary for our study.

2) **Main Study — Class lectures (approximately 4-8 lectures)** – You will be studied across approximately 4-8 lectures with the goal of comparing your experience of teaching lectures with and without haptic reminders. These lectures (with and without haptic reminders) will alternate on a predetermined schedule (e.g., 2 lectures with haptic reminders followed by 2 without, repeated).

   Lectures with haptic reminders: During your lecture, you will wear a watch-like device that delivers haptic reminders in the form of discreet vibrations at specific time intervals. These reminders can be customized to your personal preferences. Your lecture will be video recorded, with post-hoc observation of the usage patterns for this haptic reminder device.

Lectures without haptic reminders: You will teach your class without receiving any haptic reminders. You will revert to using your usual timing strategies while teaching the class. Your lecture will be video recorded, with post-hoc observation of your lecture style and timing strategies.

3) Post-Study Questionnaire (approximately 10 minutes) – After each lecture, you will be asked to fill out a brief online post-questionnaire (the same questionnaire each time) that asks you about your experience with lecture timing and the haptic reminders you received in the study, as compared to your usual timing strategies. You will be emailed instructions and a link to this questionnaire, which you are encouraged to complete right after each lecture for a more accurate recollection of your experience.

4) Post-interview (approximately 15 minutes) – After all the sessions are complete, there will be a brief interview session to further learn of your experience with and without haptic reminders while lecturing. You will also be asked to comment on areas that the haptic reminder system could improve upon to make it more valuable for lecture use.

Potential Risks and Benefits
There are no known risks or benefits to completing this questionnaire. However, your participation in this questionnaire will be tremendously valuable to our continued research efforts in improving the quality and timeliness of future lectures.

Confidentiality
All data collected from the questionnaire will be kept confidential. Your contact information will be used only by the experimenter as a means for contacting you with instructions regarding the study. All data will be stored securely in a locked metal filing cabinet or in a password-protected computer account accessible only to the experimenter. All data will also be coded so that your anonymity will be protected in any reports, research papers, thesis documents, and presentations on this work.

Contact for information about the study
Please contact Diane Tam (phone: xxx-xxx-xxxx / email: <email address>) if you require assistance with the completion of the questionnaire or have questions about the study.

Contact for information about the rights of research subjects
If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Consent
We intend for your participation in this project to be pleasant and stress-free. Your participation is entirely voluntary and you may refuse to participate or withdraw from the study at any time.

Your consent to participate in this pre-study questionnaire (Part 1) will be assumed upon its completion and submission.

B.7 Class Lecture (Main and Post-Study)

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science
2366 Main Mall
Vancouver, B.C., V6T 1Z4
Canada

Exploring Presentation Timing Through Haptic Reminders

Main and Post-Study

Consent Form for LECTURER

Principal Investigators
Dr. Karon MacLean, Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Joanna McGrenere, Associate Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Katherine J. Kuchenbecker, Assistant Professor, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, xxx-xxx-xxxx.

Co-Investigators
Diane Tam, MSc student, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Study Purpose
We will be evaluating how and to what degree haptic reminders <link to haptic reminder device description here> may have value to a lecturer as a means of helping him/her teach a class in a timely manner. This will lend insight into how haptic reminders may be perceived, and further inform design implications most suited for class lecture use.

Procedure
The full study has four parts. Completing any part does not obligate your further participation. You may withdraw from the study at any time.

1) **Pre-Study Questionnaire (approximately 10 minutes)** – This online questionnaire will gather background information with regards to personal lecturing and timing experiences necessary for our study.

2) **Main Study — Class lectures (approximately 4-8 lectures)** – You will be studied across approximately 4-8 lectures with the goal of comparing your experience of teaching lectures with and without haptic reminders. These lectures (with and without haptic reminders) will alternate on a predetermined schedule (e.g., 2 lectures with haptic reminders followed by 2 without, repeated).

   Lectures with haptic reminders: During your lecture, you will wear a watch-like device that delivers haptic reminders in the form of discreet vibrations at specific time intervals. These reminders can be customized to your personal preferences. Your lecture will be video recorded, with post-hoc observation of the usage patterns for this haptic reminder device.

Lectures without haptic reminders: You will teach your class without receiving any haptic reminders. You will revert to using your usual timing strategies while teaching the class. Your lecture will be video recorded, with post-hoc observation of your lecture style and timing strategies.

3) **Post-Study Questionnaire (approximately 10 minutes)** – After each lecture, you will be asked to fill out a brief online post-questionnaire (the same questionnaire each time) that asks you about your experience with lecture timing and the haptic reminders you received in the study, as compared to your usual timing strategies. You will be emailed instructions and a link to this questionnaire, which you are encouraged to complete right after each lecture for a more accurate recollection of your experience.

4) **Post-interview (approximately 15 minutes) –** After all the sessions are complete, there will be a brief interview session to further learn of your experience with and without haptic reminders while lecturing. You will also be asked to comment on areas that the haptic reminder system could improve upon to make it more valuable for lecture use.

Preparation
By a week or more before the first lecture of the study, you will receive an email with full instructions regarding opportunities to become familiarized and comfortable with the haptic reminder device. You will be fully informed on how to wear the device, when you will receive the reminders, what the reminders will feel like, and how to interact with the device. An experimenter or assistant to the study will be available to answer any questions you have about the instructions or procedures of this study anytime before, during, and after the lectures.

Time Commitment
You will be observed while teaching approximately 4-8 lectures, where each lecture has been scheduled for approximately 50-80 minutes. Thus, your total time commitment for the study, including the lectures, questionnaires, interviews and system familiarization phases, ranges from approximately 6 to 12 hours.

Potential Risks
There are no known risks to your participation in this study.

Confidentiality
All data collected from the questionnaires, interviews, and video recordings will be kept confidential. Your contact information will be used only by the experimenter as a means for contacting you with instructions regarding the study. All data will be stored securely in a locked metal filing cabinet or in a password-protected computer account accessible only to the experimenter. All data will also be coded so that your anonymity will be protected in any reports, research papers, thesis documents, and presentations on this work.

Benefits
You will have the opportunity to benefit from a private haptic reminder system while teaching one or more class lectures. This may potentially alleviate the manual task of time checking, while helping you teach your class in a timely manner.

Your participation will also help inform further design implications that may improve the quality and timeliness of future lectures.

Compensation
You will be compensated with a small gift of value $20, such as a Starbucks' gift card, for your participation in the study.

Contact for information about the study
Please contact Diane Tam (phone: xxx-xxx-xxxx / email: <email address>) if you require assistance with the completion of the questionanire or have questions about the study.

Contact for information about the rights of research subjects
If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Consent
We intend for your participation in this project to be pleasant and stress-free. Your participation is entirely voluntary and you may refuse to participate or withdraw from the study at any time, including just before or during your lecture itself; for example, you may signal to the experimenter to turn off the device if you become uncomfortable.

Your full consent will be requested AT a demo session prior to the first lecture of the study, and be required in order for your participation to continue.

Participation
In order to expedite the consent process for your participation in the lecture phase of the study, we have walked you through the consent document provided here, and now ask you to indicate the study variant to which you plan to consent. YOUR CONSENT WILL NOT BE ASSUMED UNTIL YOU HAVE SIGNED, DATED AND RETURNED THIS FORM.

If you choose to change your decision of consent, you may do so at anytime by contacting the experimenter.

I have read the study details above, and am consenting to:

Haptic Reminder Device:

- ☐ WEARING the haptic reminder device during my lectures.
- ☐ NOT WEARING the haptic reminder device during my lectures.

Video Recording:

- ☐ BEING VIDEO RECORDED during my lectures.
- ☐ NOT BEING VIDEO RECORDED during my lectures.

Post-Questionnaire:

- ☐ COMPLETING the post-questionnaire following each lecture.
- ☐ NOT COMPLETING the post-questionnaire following each lecture.

Post-Interview:

- ☐ PARTICIPATING in the post-interview session following my lectures.
- ☐ NOT PARTICIPATING in the post-interview session following my lectures.

I hereby CONSENT to participate in this study and acknowledge RECEIPT of a copy of the consent form:

NAME _____ DATE _____
(please print)

SIGNATURE _____

B.8 Class Lecture (Post-Study Interview)

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science
2366 Main Mall
Vancouver, B.C., V6T 1Z4
Canada

Exploring Presentation Timing Through Haptic Reminders

Post-Study Interview

Consent Form for LECTURER

Principal Investigators
Dr. Karon MacLean, Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Joanna McGrenere, Associate Professor, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Dr. Katherine J. Kuchenbecker, Assistant Professor, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, xxx-xxx-xxxx.

Co-Investigators
Diane Tam, MSc student, Department of Computer Science, University of British Columbia, xxx-xxx-xxxx.

Study Purpose
We will be evaluating how and to what degree haptic reminders may have value to a lecturer as a means of helping him/her teach a class in a timely manner. This will lend insight into how haptic reminders may be perceived, and further inform design implications most suited for class lecture use.

Procedure
The full study has four parts, of which this interview is the last. Completing any part does not obligate your further participation. You may withdraw from the study at any time.

1) **Pre-Study Questionnaire (approximately 10 minutes) —** This online questionnaire will gather background information with regards to personal lecturing and timing experiences necessary for our study.

2) **Main Study — Class lectures (approximately 4-8 lectures) —** You will be studied across approximately 4-8 lectures with the goal of comparing your experience of teaching lectures with and without haptic reminders. These lectures (with and without haptic reminders) will alternate on a predetermined schedule (e.g., 2 lectures with haptic reminders followed by 2 without, repeated).

   Lectures with haptic reminders: During your lecture, you will wear a watch-like device that delivers haptic reminders in the form of discreet vibrations at specific time intervals. These reminders can be customized to your personal preferences. Your lecture will be video recorded, with post-hoc observation of the usage patterns for this haptic reminder device.

Lectures without haptic reminders: You will teach your class without receiving any haptic reminders. You will revert to using your usual timing strategies while teaching the class. Your lecture will be video recorded, with post-hoc observation of your lecture style and timing strategies.

3) **Post-Study Questionnaire (approximately 10 minutes) —** After each lecture, you will be asked to fill out a brief online post-questionnaire (the same questionnaire each time) that asks you about your experience with lecture timing and the haptic reminders you received in the study, as compared to your usual timing strategies. You will be emailed instructions and a link to this questionnaire, which you are encouraged to complete right after each lecture for a more accurate recollection of your experience.

4) **Post-interview (approximately 15 minutes) —** After all the sessions are complete, there will be a brief interview session to further learn of your experience with and without haptic reminders while lecturing. You will also be asked to comment on areas that the haptic reminder system could improve upon to make it more valuable for lecture use.

Preparation
By a week or more before the first lecture of the study, you will receive an email with full instructions regarding opportunities to become familiarized and comfortable with the haptic reminder device. You will be fully informed on how to wear the device, when you will receive the reminders, what the reminders will feel like, and how to interact with the device. An experimenter or assistant to the study will be available to answer any questions you have about the instructions or procedures of this study anytime before, during, and after the lectures.

Time Commitment
You will be observed while teaching approximately 4-8 lectures, where each lecture has been scheduled for approximately 50-80 minutes. Thus, your total time commitment for the study, including the lectures, questionnaires, interviews and system familiarization phases, ranges from approximately 6 to 12 hours.

Potential Risks
There are no known risks to your participation in this study.

Confidentiality
All data collected from the questionnaires, interviews, and video recordings will be kept confidential. Your contact information will be used only by the experimenter as a means for contacting you with instructions regarding the study. All data will be stored securely in a locked metal filing cabinet or in a password-protected computer account accessible only to the experimenter. All data will also be coded so that your anonymity will be protected in any reports, research papers, thesis documents, and presentations on this work.

Benefits
You will have the opportunity to benefit from a private haptic reminder system while teaching one or more class lectures. This may potentially alleviate the manual task of time checking, while helping you teach your class in a timely manner.

Your participation will also help inform further design implications that may improve the quality and timeliness of future lectures.

Compensation
You will be compensated with a small gift of value $20, such as a Starbucks' gift card, for your participation in the study.

Contact for information about the study
Please contact Diane Tam (phone: xxx-xxx-xxxx / email: <email address>) if you require assistance with the completion of the questionanire or have questions about the study.

Contact for information about the rights of research subjects
If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598.

Consent
We intend for your participation in this project to be pleasant and stress-free. Your participation is entirely voluntary and you may refuse to participate or withdraw from the study at any time.

YOUR CONSENT WILL NOT BE ASSUMED UNTIL YOU HAVE SIGNED, DATED AND RETURNED THIS FORM.

Participation
I have read the study details above, and am consenting to:

Video Recording:

- ☐ BEING VIDEO RECORDED during the interview session.
- ☐ NOT BEING VIDEO RECORDED during the interview session.

Audio Recording:

- ☐ BEING AUDIO RECORDED during the interview session.
- ☐ NOT BEING AUDIO RECORDED during the interview session.

Post-Interview:

- ☐ PARTICIPATING in the post-interview session following my lectures.
- ☐ NOT PARTICIPATING in the post-interview session following my lectures.

I hereby CONSENT to participate in this study and acknowledge RECEIPT of a copy of the consent form:

NAME _____ DATE _____
(please print)

SIGNATURE _____

Appendix C

Surveys

C.1 Haptics Symposium Speaker (Pre-Study)

Exploring Presentation Timing Through Haptic Reminders
SPEAKER PRE-STUDY QUESTIONNAIRE

Please take a few minutes to answer the following questions. This questionnaire will help inform us of your interest and willingness to participate, and gather background information necessary for our study.

Thank you again for your co-operation.

Section 1 - Background

1. **Name** *(First Last)*: _____
2. **Email Address:** _____
3. **Phone Number** (optional): _____
4. **Gender:**
   - ☐ M
   - ☐ F
5. **To which age group do you belong?**
   - ☐ < 20
   - ☐ 20-29
   - ☐ 30-39
   - ☐ 40-49
   - ☐ 50-59
   - ☐ 60-69
   - ☐ 70 +
6. **Which of the following best describes your current status:**
   - ☐ Undergraduate Student
   - ☐ Master's Student
   - ☐ Doctoral Student
   - ☐ Postdoc or Research Associate
   - ☐ Faculty
   - ☐ Industry or government employee, primarily research
   - ☐ Industry or government employee, primarily non-research
   - ☐ Other: *(please specify)* _____
7. **If you are currently in academia (*Student, Postdoc, Faculty, or Other - academia related*), what is your current field of study?** *Leave blank if not applicable.*

   _____
8. **If you are currently working in industry or government, what is your current position in this entity?** *Leave blank if not applicable.*

   _____

Section 2 - Presentation Experience

1. **How many oral presentations have you previously given at conferences?**
   - ☐ 0
   - ☐ 1-2
   - ☐ 3-5
   - ☐ 6-10
   - ☐ 11+

   If you answered 0, have you ever given an oral presentation in a setting other than a conference where ending on time was important?
   - ☐ No. I have never given an oral presentation.
   - ☐ No. I have given an oral presentation BUT never had any timing constraints.
   - ☐ Yes

   If you answered **YES**, please briefly describe this presentation setting *(e.g., class project presentation, student research presentation, guest lecture): If you have presented in more than one setting where ending on time was important, please choose the setting that required more timing practice.*

   _____

*If **No**, please skip to **Section 5**.*
*If **Yes**, proceed to **Section 2 - Question 2** using this presentation setting to answer the questions. (Actual web questionnaire will branch accordingly.)*

2. Considering your allotted presentation times, which statement below best applies to you?

- ☐ My presentations typically end too early.
- ☐ My presentations typically end on time.
- ☐ My presentations typically go over time.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
3. I prepare for my presentations by:					
a. Timing the full presentation.	☐	☐	☐	☐	☐
b. Timing sections of my talk *(e.g., I should be at slide X at the 10 minute mark, section Y should take 2 minutes)*.	☐	☐	☐	☐	☐
c. Knowing what sections of my talk to skip in case I am short on time.	☐	☐	☐	☐	☐
4. During the real presentation, I typically find myself:					
a. Skipping presentation content.	☐	☐	☐	☐	☐
b. Rushing through presentation content.	☐	☐	☐	☐	☐
c. Adding more (unplanned) presentation content on the spot.	☐	☐	☐	☐	☐
5. When presenting, getting through all my intended presentation content is important to me.	☐	☐	☐	☐	☐
6. I am confident in my abilities to present.	☐	☐	☐	☐	☐
7. I am confident in my abilities to keep my presentations on time.	☐	☐	☐	☐	☐

Section 3 - Use of Timing Aids

1. Do you use any form(s) of timing aid *(e.g., wristwatch, laptop timer, wall clock)* to help you keep track of the time while you present? *NOTE: We are NOT considering timing support from another person at this point (e.g., session chair, co-author).*

- ☐ Yes
- ☐ No

*If **No**, please answer the following:*

i. Why do you NOT use any timing aids? *Check all that apply.*
- ☐ Keeping track of time is not one of my responsibilities.
- ☐ Timing aids distract me when I am presenting.
- ☐ Timing aids make me nervous when I am presenting.
- ☐ I have a timing aid, but forget to use it when I am presenting.
- ☐ I have practiced my presentation enough and am consistent in ending on time. Other: *(please specify)* _____

ii. How are you ensuring your presentation ends on time? *Check all that apply.*
- ☐ Ensuring a timely presentation is not one of my responsibilities.
- ☐ I hope my presentation will end on time.
- ☐ I know my presentation will end on time due to practice.
- ☐ I rely on someone to tell me if I am out of time.
- ☐ Other: *(please specify)* _____

*Then skip to **Section 4**.*

2. What form(s) of timing aid do you use to help you keep track of the time while you present? *Check all that apply.*

- ☐ Wristwatch
- ☐ Computer timer (e.g., laptop clock)
- ☐ Presentation software timer (e.g., Microsoft PowerPoint timer)
- ☐ Cellphone or smartphone
- ☐ Venue provided timing aid (e.g., countdown floor display, wall clock)
- ☐ Other: *(please specify)* _____

3. Timing Aid:

a. Name the timing aid you use most when presenting *(e.g., iPhone timer)*

_____

For the remaining questions on this page, please answer with respect to the timing aid you specified in Question <#>.

b. How do you use this timing aid to keep track of the time? *Check all that apply.*

- ☐ I start a *countdown* timer at the beginning of my presentation.
- ☐ I start a *stopwatch* timer at the beginning of my presentation.
- ☐ While presenting, I look at the *current time* to see how much time I have left.
- ☐ I set a *silent alarm* to notify me when my time is up. *(e.g., cellphone in pocket)*
- ☐ Other: *(please specify)* _____

c. What do you like about this timing aid? *Check all that apply. Leave blank if none.*

- ☐ It is reliable.
- ☐ It is simple to use.
- ☐ It is easy to refer to.
- ☐ Its timing information is easy to understand.
- ☐ Its timing information is easy to notice.
- ☐ It automatically notifies me of important time reminders.
- ☐ Other: *(please specify)* _____

d. What do you dislike about this timing aid? *Check all that apply. Leave blank if none.*

- ☐ It is unreliable.
- ☐ It is distracting.
- ☐ It is difficult to use.
- ☐ It is difficult to refer to.
- ☐ Its timing information is difficult to understand.
- ☐ Its timing information is easy to miss.
- ☐ It requires me to manually refer to it in order to keep track of the time.
- ☐ Other: *(please specify)* _____

e. How would you improve the way this timing aid helps you keep track of time? *Leave blank if none.*

_____

f. For this timing aid, please check one for each of the following:

As a speaker, I …	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Rely on this timing aid to keep track of the time.	☐	☐	☐	☐	☐
2. Easily notice important time reminders from this timing aid while presenting.	☐	☐	☐	☐	☐
3. Am able to focus on presenting when using this timing aid.	☐	☐	☐	☐	☐
4. Am satisfied with this timing aid in helping me keep track of time.	☐	☐	☐	☐	☐

Section 4 - Presenting with a Session Chair

1. Have you ever presented in a setting where a session chair reminded you of the time?

- ☐ Yes
- ☐ No

*If you answered **No**, skip to **Section 5**.*
*If you answered **Yes**, please proceed to **Section 4 - Question 2**.*

2. How has a session chair reminded you of the time? *Check all that apply.*

- ☐ Verbally informed me of the time remaining.
- ☐ Waved a sign in the air indicating the time remaining.
- ☐ Stood up as an indication to me that time was up.
- ☐ Other: *(please specify)* _____

3. Session Chair Reminder

a. Of all the ways a session chair has reminded you of the time, which way do you prefer? *(e.g., waving a sign) If you have only experienced one form of session chair reminder, leave this field blank.*

_____

For the remaining questions on this page, please answer with respect to your response in Question <#> (or Question <#> if you have only experienced one form of session chair reminder).

b. What do you like about being reminded this way by the session chair? *Check all that apply. Leave blank if none.*

- ☐ It is reliable.
- ☐ It is easy to refer to.

- ☐ It is easy to understand.
- ☐ It is easy to notice.
- ☐ It is noticeable by the audience.
- ☐ I do not have to configure anything.
- ☐ Other: *(please specify)* _____

c. What do you dislike about being reminded this way by the session chair? *Check all that apply. Leave blank if none.*

- ☐ It is unreliable.
- ☐ It is distracting.
- ☐ It is difficult to refer to.
- ☐ It is difficult to understand.
- ☐ It is easy to miss.
- ☐ It is noticeable by the audience.
- ☐ Other: *(please specify)* _____

d. How would you improve the way the session chair reminds you of the time? *Leave blank if none.*

_____

e. Please check one for each of the following:

The session chair reminders …	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Are easy to notice while presenting.	☐	☐	☐	☐	☐
2. Allow me to focus on presenting without monitoring the time myself.	☐	☐	☐	☐	☐
As a speaker, I …					
3. Rely on the session chair reminders to keep track of the time.	☐	☐	☐	☐	☐
4. Am satisfied with the way the session chair reminds me of the time.	☐	☐	☐	☐	☐
5. Prefer the way the session chair reminds me of the time over my usual timing aids. *(If you DON'T use any timing aids, leave this blank)*	☐	☐	☐	☐	☐

Section 5 - Additional Comments

What additional comments do you have about oral presentations or time reminders?

_____

_____

_____

_____

_____

_____

Thank you for your participation!

C.2 Haptics Symposium Speaker (Post-Study)

Exploring Presentation Timing Through Haptic Reminders
SPEAKER POST-STUDY QUESTIONNAIRE

Please take a few minutes to answer the following questions. This questionnaire will help further inform design implications for haptic reminders that may improve the quality and timeliness of future presentation sessions.

Thank you again for your co-operation.

Name *(First Last)*: _____

Section 1 - Conference Presentation

1. **Please select your conference presentation from the following list:**
   <dropdown list with all the talks organized by sessions>

2. **Were you able to finish this presentation within your allotted time?**
   - ☐ Yes, I finished with time to spare.
   - ☐ Yes, I finished on time.
   - ☐ No, I went over time.
   - ☐ I don't know.

3. **Did you have to skip over any presentation content due to timing constraints?**
   - ☐ No
   - ☐ Yes, I skipped a little bit of content.
   - ☐ Yes, I skipped a lot of content.
   - ☐ I don't remember.

4. **Did you have to rush through any presentation content due to timing constraints?**
   - ☐ No
   - ☐ Yes, I rushed through a little bit of content.
   - ☐ Yes, I rushed through a lot of content.
   - ☐ I don't remember.

5. **While presenting, did you add any unplanned content to your presentation on the spot?**
   - ☐ No
   - ☐ Yes, I added a little bit of unplanned content.
   - ☐ Yes, I added a lot of unplanned content.
   - ☐ I don't remember.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
6. I prepared for my presentation by:					
a. Timing the full presentation.	☐	☐	☐	☐	☐
b. Timing sections of my talk *(e.g., I should be at slide X at the 10 minute mark, section Y should take 2 minutes)*.	☐	☐	☐	☐	☐
c. Knowing what sections of my talk to skip in case I was short on time.	☐	☐	☐	☐	☐
7. The outcome of my real presentation was similar to how I practiced it.	☐	☐	☐	☐	☐
8. I am satisfied with the overall pace of my presentation. *(e.g., the amount of time spent on each section of the presentation)*	☐	☐	☐	☐	☐
9. Overall, my presentation went well.	☐	☐	☐	☐	☐

Section 2 - Presentation Reminders

1. **Did you wear the Haptic Reminder device during your presentation?**
   - ☐ Yes
   - ☐ No

   *If you answered **Yes**, please proceed to **Section 2 - Question 2 (Haptic Reminders).***
   *If you answered **No**, please proceed to **Section 2 - Question 3 (Session Chair Reminders).***

2. **Haptic Reminders**

   a. **What made you interested in wearing the haptic reminder device during your presentation?** *Check all that apply. Leave blank if none.*
      - ☐ I was curious about the new haptic device.
      - ☐ I was curious as to how the haptic reminders would feel while presenting.

- ☐ I was curious as to how the haptic reminders would help me keep track of time.
- ☐ Other: *(please specify)* _____

b. Did you have any concerns about wearing the haptic reminder device during your presentation? *Check all that apply. Leave blank if none.*

- ☐ I was worried the haptic device would be difficult to use.
- ☐ I was worried the haptic reminders would disrupt my presentation.
- ☐ I was worried the haptic reminders would startle me while presenting.
- ☐ I was worried I would miss the haptic reminders and lose track of time.
- ☐ Other: *(please specify)* _____

c. What do you like about the haptic reminder device? *Check all that apply. Leave blank if none.*

- ☐ It is reliable.
- ☐ It is simple to use.
- ☐ It is easy to refer to.
- ☐ Its reminders are easy to understand.
- ☐ Its reminders are easy to notice.
- ☐ It automatically notifies me of important time reminders.
- ☐ Other: *(please specify)* _____

d. What do you dislike about the haptic reminder device? *Check all that apply. Leave blank if none.*

- ☐ It is unreliable.
- ☐ It is difficult to use.
- ☐ It is difficult to refer to.
- ☐ Its reminders are distracting.
- ☐ Its reminders are difficult to understand.
- ☐ Its reminders are easy to miss.
- ☐ It requires me to manually refer to it in order to keep track of the time.
- ☐ Other: *(please specify)* _____

e. For your presentation, you were given the following reminders:

- 3 minutes left
- 1 minute left
- 0 minutes left

i. Are these good places to be reminded for you? If ***No***, what would you change these places to?

Please **list** below following these examples *(you may list as many as you like)*:

- *'X* minutes in' *(e.g., 10 minutes into my talk)*
- *'X* minutes left' *(e.g., 5 minutes until my time is up)*
- Halfway through
- When my time is up

_____
_____
_____

f. Was it difficult to remember what the haptic reminders meant *(i.e., how much time remained)* while presenting?

- ☐ Yes
- ☐ No

g. If you answered YES above, why was it difficult? *Check all that apply.*

- ☐ It was difficult to remember each reminder based on the haptic stimuli mapping alone. *e.g., A slow gradual reminder means that 3 minutes is left, a more urgent (faster and stronger) haptic reminder means that time is up.*
- ☐ I was trying to remember the reminders based on the order they occurred but I lost track while presenting. *e.g., First reminder is the 3 minute reminder, Second reminder is the 1 minute reminder, etc...*
- ☐ Other: *(please specify)* _____

h. If you answered NO above, what helped you remember what each haptic reminder meant? *Check all that apply.*

- ☐ The haptic stimuli mapping to the time remaining. *e.g., '3 minutes left' was associated with a slow gradual reminder, 'Time Is Up' was associated with a more urgent (faster and stronger) haptic reminder.*
- ☐ The order of the reminders. *e.g., First reminder is the 3 minute reminder, Second reminder is the 1 minute reminder, etc…*
- ☐ Other: *(please specify)* _____

i. Upon noticing a haptic reminder, how did you acknowledge it? *If you acknowledged in more than one way, select the way you prefer most.*

- ☐ No acknowledgement. I let the reminder continue until it stopped.
- ☐ I stopped the reminder myself by touching the device.
- ☐ I made eye contact with the session chair(s).
- ☐ I nodded my head to the session chair(s).

- ☐ I don't remember.
- ☐ Other: *(please specify)* _____

j. For your response in Question <#>, why did you acknowledge the haptic reminders this way? *Check all that apply. Leave blank if not applicable.*

- ☐ Because it required no effort.
- ☐ Because it was easy to do.
- ☐ Because it was not distracting.
- ☐ Because I wanted to stop the reminders right away.
- ☐ Because I wanted to let the session chair(s) know that I was aware of the time remaining.
- ☐ Other: *(please specify)* _____

k. How would you improve the way reminders are acknowledged? *Leave blank if none.*

_____

l. How would you improve the haptic reminders? *(e.g., make the reminder stronger) Leave blank if none.*

_____

m. How would you improve the haptic reminder device? *(e.g., change the material) Leave blank if none.*

_____

n. What additional improvements would you suggest for the OVERALL functionality of the Haptic Reminder device in supporting you as a speaker? *Leave blank if none.*

_____

o. Please check one for each of the following:

As a speaker, I …	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Relied on the haptic reminders to keep track of the time.	☐	☐	☐	☐	☐
2. Am satisfied with the haptic reminders in helping me keep track of time.	☐	☐	☐	☐	☐
The haptic reminders…					
3. Allowed me to focus on presenting, without monitoring the time myself.	☐	☐	☐	☐	☐
4. Were not distracting.	☐	☐	☐	☐	☐
5. Were easy to understand.	☐	☐	☐	☐	☐
6. Were easy to notice.	☐	☐	☐	☐	☐
7. Were easy to acknowledge.	☐	☐	☐	☐	☐
8. Were easy to acknowledge without losing focus.	☐	☐	☐	☐	☐
The haptic reminder device …					
9. Was easy to interact with.	☐	☐	☐	☐	☐
10. Would be useful to me for a future presentation.	☐	☐	☐	☐	☐
11. Is better than my usual timing aids in helping me keep track of time.	☐	☐	☐	☐	☐

3. Session Chair Reminders ***(skip this section if you wore the Haptic Reminder device)***

a. What made you decide not to wear the haptic reminder device during your presentation? *Check all that apply. Leave blank if none.*

- ☐ I was worried the haptic device would be difficult to use.
- ☐ I was worried the haptic reminders would disrupt my presentation.
- ☐ I was worried the haptic reminders would startle me while presenting.
- ☐ I was worried I would miss the haptic reminders and lose track of time.
- ☐ Other: *(please specify)* _____

b. What do you like about the session chair's use of paper signs as time reminders? *Check all that apply. Leave blank if none.*

- ☐ They are reliable.
- ☐ They are easy to refer to.
- ☐ They are easy to understand.
- ☐ They are easy to notice.
- ☐ They are noticeable by the audience.
- ☐ I do not have to configure anything.
- ☐ Other: *(please specify)* _____

c. What do you dislike about the session chair's use of paper signs as time reminders? *Check all that apply. Leave blank if none.*

- ☐ They are unreliable.
- ☐ They are distracting.

- ☐ They are difficult to refer to.
- ☐ They are difficult to understand.
- ☐ They are easy to miss.
- ☐ They are noticeable by the audience.
- ☐ Other: *(please specify)* _____

d. For your presentation, you were given the following reminders:

- 3 minutes left
- 1 minute left
- 0 minutes left

i. Are these good places to be reminded for you? If ***No***, what would you change these places to?

Please **list** below following these examples *(you may list as many as you like)*:

- *'X* minutes in' *(e.g., 10 minutes into my talk)*
- *'X* minutes left' *(e.g., 5 minutes until my time is up)*
- Halfway through
- When my time is up

_____
_____
_____

e. Upon noticing a reminder from the session chair, how did you acknowledge it? *If you acknowledged in more than one way, select the way you prefer most.*

- ☐ No acknowledgement. I did nothing.
- ☐ I made eye contact with the session chair(s).
- ☐ I nodded my head to the session chair(s).
- ☐ I don't remember.
- ☐ Other: *(please specify)* _____

f. For your response in Question <#>, why did you acknowledge the session chair reminders this way? *Check all that apply. Leave blank if not applicable.*

- ☐ Because it required no effort.
- ☐ Because it was easy to do.
- ☐ Because it was not distracting.
- ☐ Because I wanted to let the session chair(s) know that I was aware of the time remaining.
- ☐ Other: *(please specify)* _____

g. How would you improve the way reminders are acknowledged? *Leave blank if none.*

_____

h. How would you improve the way the session chair reminds you of the time? *Leave blank if none.*

_____

i. Please check one for each of the following:

As a speaker, I …	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Relied on the session chair reminders to keep track of the time.	☐	☐	☐	☐	☐
2. Am satisfied with the session chair reminders in helping me keep track of the time.	☐	☐	☐	☐	☐
The session chair reminders …					
3. Allowed me to focus on presenting, without monitoring the time myself.	☐	☐	☐	☐	☐
4. Were not distracting.	☐	☐	☐	☐	☐
5. Were easy to understand.	☐	☐	☐	☐	☐
6. Were easy to notice.	☐	☐	☐	☐	☐
7. Were easy to acknowledge.	☐	☐	☐	☐	☐
8. Were easy to acknowledge without losing focus.	☐	☐	☐	☐	☐
9. Would be useful to me for a future presentation.	☐	☐	☐	☐	☐
10. Are better than my usual timing aids in helping me keep track of time.	☐	☐	☐	☐	☐

Section 3 - Use of Timing Aids

1. In addition to the Haptic/Session Chair Reminders, did you use another form of timing aid *(e.g., wristwatch, laptop timer, wall clock)* to help you keep track of the time while presenting?

☐ Yes
☐ No

*If No, please skip to **Section 4**.*

2. What form(s) of timing aid did you use to help you keep track of the time while presenting? *Check all that apply.*

☐ Wristwatch
☐ Computer timer (e.g., laptop clock)
☐ Presentation software timer (e.g., Microsoft PowerPoint timer)
☐ Cellphone or smartphone
☐ Venue provided timing aid (e.g., countdown floor display, wall clock)
☐ Other: *(please specify)* _____

3. Timing Aid:

a. Name the timing aid you used <u>most</u> while presenting *(e.g., iPhone timer)*

_____

For the remaining questions on this page, please answer with respect to the timing aid you specified in Question <#>.

b. Why did you use this timing aid even though you were <u>already</u> wearing the Haptic Reminder device / receiving reminders from the session chair(s)? *Check all that apply.*

☐ I wanted a backup timing aid just in case I <u>missed</u> the haptic/session chair reminders.
☐ I wanted a backup timing aid just in case I had trouble <u>using</u> the haptic reminder device.
☐ I wanted a backup timing aid just in case I had trouble <u>understanding</u> the haptic/session chair reminders.
☐ I wanted <u>additional</u> timing information available to me while presenting.
☐ I wanted to use my <u>own</u> timing aid while presenting.
☐ Other: *(please specify)* _____

c. What features of this timing aid would help <u>improve</u> your use of the Haptic Reminder device / session chair reminders while presenting?

_____

<u>Section 4 - Additional Comments</u>

What additional comments do you have about your experience with the haptic reminder device, session chair reminders, or your overall experience with presentation timing at the conference?

_____
_____
_____
_____
_____
_____

Thank you for your participation!

C.3 Haptics Symposium Session Chair (Pre-Study)

Exploring Presentation Timing Through Haptic Reminders
MODERATOR PRE-STUDY QUESTIONNAIRE

Please take a few minutes to answer the following questions. This questionnaire will help inform us of your interest and willingness to participate, and gather background information necessary for our study.

Thank you again for your co-operation.

Section 1 - Background

1. **Name** *(First Last)*: _____
2. **Email Address:** _____
3. **Phone Number** (optional): _____
4. **Gender:**
   - ☐ M
   - ☐ F
5. **To which age group do you belong?**
   - ☐ < 20
   - ☐ 20-29
   - ☐ 30-39
   - ☐ 40-49
   - ☐ 50-59
   - ☐ 60-69
   - ☐ 70 +
6. **Which of the following best describes your current status:**
   - ☐ Undergraduate Student
   - ☐ Master's Student
   - ☐ Doctoral Student
   - ☐ Postdoc or Research Associate
   - ☐ Faculty
   - ☐ Industry or government employee, primarily research
   - ☐ Industry or government employee, primarily non-research
   - ☐ Other: *(please specify)* _____
7. **If you are currently in academia (*Student, Postdoc, Faculty, or Other - academia related*), what is your current field of study?** *Leave blank if not applicable.*

   _____
8. **If you are currently working in industry or government, what is your current position in this entity?** *Leave blank if not applicable.*

   _____

Section 2 - Session Chairing Experience

1. **How many oral presentation sessions have you previously chaired at conferences?**
   - ☐ 0
   - ☐ 1-2
   - ☐ 3-5
   - ☐ 6-10
   - ☐ 11+

   If you answered 0, have you chaired an oral presentation session in a setting *other than a conference* where it was important for speakers to *end on time*?
   - ☐ No. I have never chaired an oral presentation session.
   - ☐ No. I have chaired an oral presentation session BUT there were no timing constraints.
   - ☐ Yes

If you answered **YES**, please briefly describe this presentation setting *(e.g., class project presentations, student research presentations, guest lectures): If you chaired in more than one setting where ending on time was important, please choose the setting where timing was most enforced.*

_____

*If **No**, please skip to **Section 5**.*
*If **Yes**, proceed to **Section 2 - Question 2** using this presentation setting to answer the questions. (Actual web questionnaire will branch accordingly.)*

2. Which statement below best applies to the sessions you chair?

- ☐ My sessions typically end too early.
- ☐ My sessions typically end on time.
- ☐ My sessions typically go over time.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
3. I prepare for my chairing duties by:	☐	☐	☐	☐	☐
a. Reading the speakers' papers.	☐	☐	☐	☐	☐
b. Preparing a time schedule to help me manage my session.					
4. While chairing a session:	☐	☐	☐	☐	☐
a. I monitor the time.	☐	☐	☐	☐	☐
b. I find myself losing track of the time.	☐	☐	☐	☐	☐
c. I am unable to focus on the presentations.	☐	☐	☐	☐	☐
5. There are a lot of responsibilities as a session chair.	☐	☐	☐	☐	☐
6. I find it challenging to keep my speakers on time with their presentations.	☐	☐	☐	☐	☐
7. The methods available to me for keeping speakers on time are not sufficient.	☐	☐	☐	☐	☐

Section 3 - Issuing Time Reminders to Speakers

1. In your past chairing experiences, have you ever had to issue time reminders to speakers? If so, which method do you prefer?

- ☐ None. I have never issued time reminders to speakers before.
- ☐ Verbally informing the speaker of the time remaining.
- ☐ Waving a sign in the air indicating the time remaining.
- ☐ Standing up as an indication to the speaker that time is up.
- ☐ Other: *(please specify)* _____

*If **None**, please skip to **Section 4**.*

2. For your preferred method of reminding speakers of the time, please check one for each of the following:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
a. Speakers notice my time reminders.	☐	☐	☐	☐	☐
b. I am comfortable with interrupting speakers with my time reminders.	☐	☐	☐	☐	☐
c. I am comfortable with being noticed by the audience when issuing time reminders.	☐	☐	☐	☐	☐

Section 4 - Use of Timing Aids

1. Do you use any form(s) of timing aid *(e.g., wristwatch, cellphone, wall clock)* to help you keep track of the time while you chair?

- ☐ Yes
- ☐ No

*If **No**, please answer the following:*

i. Why do you NOT use any timing aids? *Check all that apply.*
   - ☐ Keeping track of time is not one of my responsibilities.
   - ☐ Timing aids distract me from focusing on the presentations.
   - ☐ I have a timing aid, but forget to use it when I am chairing.
   - ☐ I trust the speakers will end their presentations on time.
   - ☐ Other: *(please specify)* _____

ii. How are you ensuring the session ends on time? *Check all that apply.*

- ☐ Ensuring a timely session is not one of my responsibilities.
- ☐ I trust the speakers will end their presentations on time.
- ☐ I rely on someone to tell me if the session is out of time.
- ☐ Other: *(please specify)* _____

*Then skip to **Section 5**.*

2. What form(s) of timing aid do you use to help you keep track of the time while you chair? *Check all that apply.*

- ☐ Wristwatch
- ☐ Computer timer (e.g., laptop clock)
- ☐ Cellphone or smartphone
- ☐ Venue provided timing aid (e.g., countdown floor display, wall clock)
- ☐ Other: *(please specify)* _____

3. Timing Aid:

a. Name the timing aid you use <u>most</u> when chairing *(e.g., iPhone timer)*

_____

For the remaining questions on this page, please answer with respect to the timing aid you specified in Question <#>.

b. How do you typically use this timing aid to keep track of …

a. How much time a speaker has left?
- ☐ I do not usually keep track of this.
- ☐ I set a *countdown timer* that I restart for each speaker.
- ☐ I use a *stopwatch timer* that I restart for each speaker.
- ☐ I look at the *current time* to see how much time remains.
- ☐ I set a *silent alarm* to notify me of the time.
- ☐ Other: *(please specify)* _____

b. The time during Question and Answer (Q&A) periods?
- ☐ I do not usually keep track of this.
- ☐ I set a *countdown timer*.
- ☐ I use a *stopwatch timer*.
- ☐ I look at the *current time* to see how time remains.
- ☐ I set a *silent alarm* to notify me of the time.
- ☐ Other: *(please specify)* _____

c. The time in between speakers?
- ☐ I do not usually keep track of this.
- ☐ I set a *countdown timer*.
- ☐ I use a *stopwatch timer*.
- ☐ I look at the *current time* to see how much time remains.
- ☐ I set a *silent alarm* to notify me of the time.
- ☐ Other: *(please specify)* _____

d. The overall session time?
- ☐ I do not usually keep track of this.
- ☐ I set a *countdown timer*.
- ☐ I use a *stopwatch timer*.
- ☐ I look at the *current time* to see how time remains.
- ☐ I set a *silent alarm* to notify me of the time.
- ☐ Other: *(please specify)* _____

c. What do you like about this timing aid? *Check all that apply. Leave blank if none.*
- ☐ It is reliable.
- ☐ It is simple to use.
- ☐ It is easy to refer to.
- ☐ Its timing information is easy to understand.
- ☐ Its timing information is easy to notice.
- ☐ It automatically notifies me of important time reminders.
- ☐ Other: *(please specify)* _____

d. What do you dislike about this timing aid? *Check all that apply. Leave blank if none.*
- ☐ It is unreliable.
- ☐ It is distracting.
- ☐ It is difficult to use.
- ☐ It is difficult to refer to.

- ☐ Its timing information is difficult to understand.
- ☐ Its timing information is easy to miss.
- ☐ It requires me to manually refer to it in order to keep track of the time.
- ☐ Other: *(please specify)* _____

e. How would you improve this timing aid to support your chairing duties? *Leave blank if none.*

_____

f. For this timing aid, please check one for each of the following:

As a session chair, I …	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Rely on this timing aid to keep track of the time.	☐	☐	☐	☐	☐
2. Easily notice important time reminders from this timing aid while chairing.	☐	☐	☐	☐	☐
3. Am able to focus on the presentations when using this timing aid.	☐	☐	☐	☐	☐
4. Am satisfied with this timing aid in helping me keep track of time.	☐	☐	☐	☐	☐

Section 5 - Additional Comments

What additional comments do you have about session chair duties or time reminders?

_____
_____
_____
_____
_____
_____

Thank you for your participation!

C.4 Haptics Symposium Session Chair (Post-Study)

Exploring Presentation Timing Through Haptic Reminders
MODERATOR POST-STUDY QUESTIONNAIRE

Please take a few minutes to answer the following questions. This questionnaire will help further inform design implications for haptic reminders that may improve the quality and timeliness of future presentation sessions.

Thank you again for your co-operation.

Name *(First Last)*: _____

Section 1 - Conference Session

1. **Please select the session you chaired from the following list:**
   <dropdown list with all the conference sessions>

2. **Did the session finish within the scheduled time?**
   - ☐ Yes, it finished with time to spare.
   - ☐ Yes, it finished on time.
   - ☐ No, it went over time.
   - ☐ I don't know.

3. **How many speakers in your session ended their talks on time?**
   - ☐ All
   - ☐ All, but one.
   - ☐ About half.
   - ☐ Less than half.
   - ☐ None
   - ☐ I don't remember.
   - ☐ Other: *(please specify)* _____

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
4. I prepared for my chairing duties by:					
a. Reading the speakers' papers.	☐	☐	☐	☐	☐
b. Preparing a time schedule to help me manage my session.	☐	☐	☐	☐	☐
5. While chairing the session:					
a. I monitored the time.	☐	☐	☐	☐	☐
b. I found myself losing track of the time.	☐	☐	☐	☐	☐
c. I was unable to focus on the presentations.	☐	☐	☐	☐	☐
5. There were a lot of responsibilities as a session chair.	☐	☐	☐	☐	☐
6. I found it challenging to keep my speakers on time with their presentations.	☐	☐	☐	☐	☐
7. Overall, the session timing could be improved.	☐	☐	☐	☐	☐

Section 2 - Presentation Reminders

1. **Did you wear the Haptic Reminder device during your session?**
   - ☐ Yes
   - ☐ No

   *If you answered **Yes**, please proceed to **Section 2 - Question 2 (Haptic Reminders).***
   *If you answered **No**, please proceed to **Section 2 - Question 4 (Standard Speaker Reminders).***

2. **Haptic Reminders**

   a. **What made you interested in wearing the haptic reminder device during your session?** *Check all that apply. Leave blank if none.*
      - ☐ I was curious about the new haptic device.
      - ☐ I was curious as to how the haptic device would support my chairing duties.
      - ☐ I was curious as to how the haptic reminders would feel while chairing.
      - ☐ I was curious as to how the haptic reminders would help keep my speakers on time with their presentations.
      - ☐ Other: *(please specify)* _____

b. Did you have any concerns about wearing the haptic reminder device during your session? *Check all that apply. Leave blank if none.*

- ☐ I was worried the haptic device would be difficult to use.
- ☐ I was worried the haptic reminders would disrupt my chairing duties.
- ☐ I was worried the haptic reminders would startle me while chairing.
- ☐ I was worried I would miss the haptic reminders and lose track of time.
- ☐ I was worried the speakers would miss the haptic reminders and go over time with their presentations.
- ☐ Other: *(please specify)* _____

c. What do you like about the haptic reminder device? *Check all that apply. Leave blank if none.*

- ☐ It is reliable.
- ☐ It is simple to use.
- ☐ It is easy to refer to.
- ☐ Its reminders are easy to understand.
- ☐ Its reminders are easy to notice.
- ☐ It automatically notifies me of important time reminders.
- ☐ Other: *(please specify)* _____

d. What do you dislike about the haptic reminder device? *Check all that apply. Leave blank if none.*

- ☐ It is unreliable.
- ☐ It is difficult to use.
- ☐ It is difficult to refer to.
- ☐ Its reminders are distracting.
- ☐ Its reminders are difficult to understand.
- ☐ Its reminders are easy to miss.
- ☐ It requires me to manually refer to it in order to keep track of the time.
- ☐ Other: *(please specify)* _____

e. Was it difficult to remember what the haptic reminders meant? *(i.e., how much time remained)*

- ☐ Yes
- ☐ No

f. If you answered YES above, why was it difficult? *Check all that apply.*

- ☐ It was difficult to remember each reminder based on the haptic stimuli mapping alone. *e.g., A slow gradual reminder means that 3 minutes is left, a more urgent (faster and stronger) haptic reminder means that time is up.*
- ☐ I was trying to remember the reminders based on the order they occurred but I lost track. *e.g., First reminder is the 3 minute reminder, Second reminder is the 1 minute reminder, etc...*
- ☐ Other: *(please specify)* _____

g. If you answered NO above, what helped you remember what each haptic reminder meant? *Check all that apply.*

- ☐ The countdown timer displayed on the Session Chair (laptop) Timer Display.
- ☐ The haptic stimuli mapping to the time remaining. *e.g., '3 minutes left' was associated with a slow gradual reminder, 'Time Is Up' was associated with a more urgent (faster and stronger) haptic reminder.*
- ☐ The order of the reminders. *e.g., First reminder is the 3 minute reminder, Second reminder is the 1 minute reminder, etc…*
- ☐ Other: *(please specify)* _____

h. Upon noticing a haptic reminder, speakers may or may not have acknowledged the reminder *(e.g., by stopping the reminder, by making eye contact with a session chair)*

Do you feel it is necessary for speakers to acknowledge the reminders? *(i.e., reassurance that they are aware of the time)*

- ☐ Yes
- ☐ No

i. If you answered YES above, how would you improve the way reminders are acknowledged? *Leave blank if none.*

_____

j. In addition to receiving haptic reminders during the oral presentations, how else would haptic reminders be useful to you? *Check all that apply. Leave blank if none.*

- ☐ For keeping track of the time during Question and Answer (Q&A) periods.
- ☐ For keeping track of the time in between speakers.
- ☐ For keeping track of the overall session time.
- ☐ Other: *(please specify)* _____

k. How would you improve the haptic reminders? *(e.g., make the reminder stronger) Leave blank if none.*

_____

l. How would you improve the haptic reminder device? *(e.g., change the material) Leave blank if none.*

_____

m. Please check one for each of the following:

As a session chair, I …	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Relied on the haptic reminders to keep track of the speaker's time.	☐	☐	☐	☐	☐
2. Am satisfied with the haptic reminders in helping me keep track of time.	☐	☐	☐	☐	☐
The haptic reminders…					
3. Allowed me to focus on the presentations, without monitoring the time myself.	☐	☐	☐	☐	☐
4. Were <u>not</u> distracting.	☐	☐	☐	☐	☐
5. Were easy to understand.	☐	☐	☐	☐	☐
6. Were easy to notice.	☐	☐	☐	☐	☐
7. Were noticed by the speakers.	☐	☐	☐	☐	☐
8. Were effective at reminding speakers of the time.	☐	☐	☐	☐	☐
The haptic reminder device …					
9. Was easy to interact with.	☐	☐	☐	☐	☐
10. Would be useful to me for a future session I chair.	☐	☐	☐	☐	☐
11. Is better than my usual timing aids in helping me keep track of the speaker's time.	☐	☐	☐	☐	☐
12. Is better than the standard ways of reminding speakers of the time. *(e.g., waving a time remaining sign)*	☐	☐	☐	☐	☐

3. Session Chair (Laptop) Timer Display

a. Please check one for each of the following:

The session chair timer display…	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Was easy to use.	☐	☐	☐	☐	☐
2. Helped me keep track of the time during the oral presentations.	☐	☐	☐	☐	☐
3. Helped me keep track of the time during the Question and Answer (Q&A) periods.	☐	☐	☐	☐	☐
4. Helped me keep track of the time in between speakers.	☐	☐	☐	☐	☐
5. Helped me keep track of the overall session time.	☐	☐	☐	☐	☐
6. Is better than my usual timing aids in helping me keep track of time.	☐	☐	☐	☐	☐

b. What do you like about the session chair timer display? *Check all that apply. Leave blank if none.*

- ☐ It is reliable.
- ☐ It is simple to use.
- ☐ It is easy to refer to.
- ☐ It is easy to understand.
- ☐ Its timing information is easy to notice.
- ☐ It automatically notifies me of important time reminders.
- ☐ Other: *(please specify)* _____

c. What do you dislike about the session chair timer display? *Check all that apply. Leave blank if none.*

- ☐ It is unreliable.
- ☐ It is distracting.
- ☐ It is difficult to use.
- ☐ It is difficult to refer to.
- ☐ It is difficult to understand.
- ☐ Its timing information is easy to miss.
- ☐ It requires me to manually refer to it in order to keep track of the time.
- ☐ Other: *(please specify)* _____

d. How would you improve the session chair timer display? *Leave blank if none.*

_____

e. What <u>additional</u> improvements would you suggest for the OVERALL system (Haptic Reminder device AND Laptop Timer Display) in supporting your chairing duties? *Leave blank if none.*

_____

4. Standard Speaker Reminders ***(skip this section if you wore the Haptic Reminder device)***

a. What made you decide <u>NOT</u> to wear the haptic reminder device during your session? *Check all that apply.*

- ☐ I was worried the haptic device would be difficult to use.
- ☐ I was worried the haptic reminders would disrupt my chairing duties.
- ☐ I was worried the haptic reminders would startle me while chairing.
- ☐ I was worried I would miss the haptic reminders and lose track of time.
- ☐ I was worried the speakers would miss the haptic reminders and go over time with their presentations.
- ☐ Other: *(please specify)* _____

b. What do you like about using paper signs as a way of reminding speakers of the time remaining? *Check all that apply. Leave blank if none.*

- ☐ They are reliable.
- ☐ They are simple to use.
- ☐ They are easy to understand.
- ☐ They are easy for speakers to refer to.
- ☐ They are easy for speakers to notice.
- ☐ They are noticeable by the audience.
- ☐ I have control over how long to hold the sign up for.
- ☐ Other: *(please specify)* _____

c. What do you dislike about using paper signs as a way of reminding speakers of the time remaining? *Check all that apply. Leave blank if none.*

- ☐ They are unreliable.
- ☐ They are distracting.
- ☐ They are difficult to use.
- ☐ They are difficult to understand.
- ☐ They are difficult for speakers to refer to.
- ☐ They are difficult for speakers to notice.
- ☐ They are noticeable by the audience.
- ☐ I am unsure as to how long to hold the sign up for.
- ☐ I may forget to issue the reminder to the speakers.
- ☐ Other: *(please specify)* _____

d. Upon noticing a paper sign reminder, speakers may or may not have acknowledged the reminder *(e.g., by making eye contact with a session chair)*

Do you feel it is necessary for speakers to acknowledge the reminders? *(i.e., reassurance that they are aware of the time)*

- ☐ Yes
- ☐ No

e. If you answered YES above, how would you improve the way reminders are acknowledged? *Leave blank if none.*

_____

f. How would you improve the way speakers are reminded of the time? *Leave blank if none.*

_____

g. Please check one for each of the following:

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
a. Speakers noticed my time reminders.	☐	☐	☐	☐	☐
b. I was comfortable with interrupting the speakers with my time reminders.	☐	☐	☐	☐	☐
c. I was comfortable with being noticed by the audience when issuing my time reminders.	☐	☐	☐	☐	☐
d. Overall, the reminders were effective at reminding speakers of the time.	☐	☐	☐	☐	☐

<u>Section 3 - Use of Timing Aids</u> ***(for participants who wore the Haptic Reminder device – Actual survey will branch accordingly)***

1. In <u>addition</u> to the Haptic Reminder device and Laptop Timer Display, did you use <u>another</u> form of timing aid ***(e.g., wristwatch, cellphone, wall clock)*** **to help you keep track of the time while chairing?**

- ☐ Yes
- ☐ No

*If No, please skip to **Section 4**.*

2. What form(s) of timing aid did you use to help you keep track of the time while chairing? *Check all that apply.*

- ☐ Wristwatch
- ☐ Computer timer (e.g., laptop clock)
- ☐ Cellphone or smartphone
- ☐ Venue provided timing aid (e.g., countdown floor display, wall clock)
- ☐ Other: *(please specify)* _____

3. Timing Aid:

a. Name the timing aid you used <u>most</u> while chairing *(e.g., iPhone timer)*

_____

For the remaining questions on this page, please answer with respect to the timing aid you specified in Question <#>.

b. Why did you use this timing aid even though you were <u>already</u> wearing the Haptic Reminder device AND using the Laptop Timer Display? *Check all that apply.*

- ☐ I wanted a backup timing aid just in case I <u>missed</u> the haptic reminders.
- ☐ I wanted a backup timing aid just in case I had trouble <u>using</u> the haptic reminder device / laptop timer display.
- ☐ I wanted a backup timing aid just in case I had trouble <u>understanding</u> the haptic reminders.
- ☐ I wanted to use my own timing aid to keep track of the time during <u>presentations</u>.
- ☐ I wanted to use my own timing aid to keep track of the time during <u>Question and Answer</u> (Q&A) periods.
- ☐ I wanted to use my own timing aid to keep track of the time <u>in between</u> speakers.
- ☐ I wanted to use my own timing aid to keep track of the <u>overall</u> session time.
- ☐ Other: *(please specify)* _____

c. What features of this timing aid would help <u>improve</u> your use of the Haptic Reminder device and/or Laptop Timer Display while chairing?

_____

<u>Section 3 - Use of Timing Aids</u> ***(for participants who DID NOT wear the Haptic Reminder device)***

1. Did you use any form(s) of timing aid *(e.g., wristwatch, cellphone, wall clock)* to help you keep track of the time while chairing?

- ☐ Yes
- ☐ No

*If No, please skip to **Section 4**.*

2. What form(s) of timing aid did you use to help you keep track of the time while chairing? *Check all that apply.*

- ☐ Wristwatch
- ☐ Computer timer (e.g., laptop clock)
- ☐ Cellphone or smartphone
- ☐ Venue provided timing aid (e.g., countdown floor display, wall clock)
- ☐ Other: *(please specify)* _____

3. Timing Aid:

a. Name the timing aid you used <u>most</u> while chairing *(e.g., iPhone timer)*

_____

For the remaining questions on this page, please answer with respect to the timing aid you specified in Question <#>.

b. How did you use this timing aid to keep track of …

a. How much time a speaker had left?
   - ☐ I did not keep track of this.
   - ☐ I set a *countdown timer* that I restarted for each speaker.
   - ☐ I used a *stopwatch timer* that I restarted for each speaker.
   - ☐ I looked at the *current time* to see how much time remained.
   - ☐ I set a *silent alarm* to notify me of the time.
   - ☐ Other: *(please specify)* _____

b. The time during Question and Answer (Q&A) periods?
   - ☐ I did not keep track of this.
   - ☐ I set a *countdown timer*.
   - ☐ I used a *stopwatch timer*.
   - ☐ I looked at the *current time* to see how much time remained.

- ☐ I set a *silent alarm* to notify me of the time.
- ☐ Other: *(please specify)* _____

c. The time in between speakers?
- ☐ I did not keep track of this.
- ☐ I set a *countdown timer*.
- ☐ I used a *stopwatch timer*.
- ☐ I looked at the *current time* to see how much time remained.
- ☐ I set a *silent alarm* to notify me of the time.
- ☐ Other: *(please specify)* _____

d. The overall session time?
- ☐ I did not keep track of this.
- ☐ I set a *countdown timer*.
- ☐ I used a *stopwatch timer*.
- ☐ I looked at the *current time* to see how much time remained.
- ☐ I set a *silent alarm* to notify me of the time.
- ☐ Other: *(please specify)* _____

c. What do you like about this timing aid? *Check all that apply. Leave blank if none.*
- ☐ It is reliable.
- ☐ It is simple to use.
- ☐ It is easy to refer to.
- ☐ Its timing information is easy to understand.
- ☐ Its timing information is easy to notice.
- ☐ It automatically notifies me of important time reminders.
- ☐ Other: *(please specify)* _____

d. What do you dislike about this timing aid? *Check all that apply. Leave blank if none.*
- ☐ It is unreliable.
- ☐ It is distracting.
- ☐ It is difficult to use.
- ☐ It is difficult to refer to.
- ☐ Its timing information is difficult to understand.
- ☐ Its timing information is easy to miss.
- ☐ It requires me to manually refer to it in order to keep track of the time.
- ☐ Other: *(please specify)* _____

e. How would you improve this timing aid to support your chairing duties? *Leave blank if none.*

_____

f. For this timing aid, please check one for each of the following:

As a session chair, I …	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Relied on this timing aid to keep track of the time.	☐	☐	☐	☐	☐
2. Easily noticed important time reminders from this timing aid while chairing.	☐	☐	☐	☐	☐
3. Was able to focus on the presentations when using this timing aid.	☐	☐	☐	☐	☐
4. Am satisfied with this timing aid in helping me keep track of time.	☐	☐	☐	☐	☐

Section 4 - Additional Comments

What additional comments do you have about your experience with the haptic reminder device, session chair reminders, or your overall experience with presentation timing at the conference?

_____
_____
_____
_____
_____
_____

Thank you for your participation!

C.5 Audience (Post-Study)

Exploring Presentation Timing Through Haptic Reminders
AUDIENCE POST-CONFERENCE QUESTIONNAIRE

Please take a few minutes to answer the following questions. This questionnaire will help further inform design implications for haptic reminders that may improve the quality and timeliness of future presentation sessions.
Thank you again for your co-operation.

1. **Please select the presentation sessions you attended from the following list:**
   <dropdown list with all the presentations organized by session>

During the conference, speakers were issued time reminders while presenting to help them deliver a timely presentation.
Of the presentation sessions you attended, did you:

2. **Notice the session chairs holding up paper time reminder signs to the speakers?**
   - ☐ Yes
   - ☐ No
   - ☐ Not Sure

If YES, please briefly answer the following:	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. I noticed when the paper reminders were delivered to speakers.	☐	☐	☐	☐	☐
2. Speakers noticed the paper reminders.	☐	☐	☐	☐	☐
3. Speakers noticed the paper reminders right away.	☐	☐	☐	☐	☐
4. Speakers acknowledged the paper reminders. (e.g., nodding their head to the session chair, looking at the session chair)	☐	☐	☐	☐	☐
5. Speakers appeared distracted by the paper reminders.	☐	☐	☐	☐	☐

   a. **Did you, as an audience member, find the reminders distracting? If so, what made them distracting?** *Leave blank if none.*

   b. **Were there any other noticeable disruptions as a result of the reminders? If so, what were they?** *Leave blank if none.*

3. **Notice the Haptic Reminder device being used by the speakers and/or session chairs?**
   - ☐ Yes
   - ☐ No

If YES, please briefly answer the following:	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. I noticed when the haptic reminders were delivered to speakers.	☐	☐	☐	☐	☐
2. Speakers noticed the haptic reminders.	☐	☐	☐	☐	☐
3. Speakers noticed the haptic reminders right away.	☐	☐	☐	☐	☐
4. Speakers acknowledged the haptic reminders. (e.g., verbal acknowledgement, by interacting with the haptic reminder device, nodding their head to the session chair, looking at the session chair)	☐	☐	☐	☐	☐
5. Speakers appeared distracted by the haptic reminders.	☐	☐	☐	☐	☐

   a. **Did you, as an audience member, find the reminders distracting? If so, what made them distracting?** *Leave blank if none.*

   b. **Were there any other noticeable disruptions as a result of the haptic device and/or reminders? If so, what were they?** *Leave blank if none.*

Additional Comments

Do you have any general comments about the use of haptic and/or paper reminders as a way of keeping speakers on time with their presentations?

What additional comments do you have about the overall timeliness and flow of the sessions you attended at the conference?

Thank you for your participation!

C.6 Class Lecture (Pre-Study)

Exploring Presentation Timing Through Haptic Reminders
LECTURER PRE-STUDY QUESTIONNAIRE

Please take a few minutes to answer the following questions. This questionnaire will help inform us of your interest and willingness to participate, and gather background information necessary for our study.

Thank you again for your co-operation.

Section 1 - Background

1. **Name** *(First Last)*: _____

2. **To which age group do you belong?**
   - ☐ < 20
   - ☐ 20-29
   - ☐ 30-39
   - ☐ 40-49
   - ☐ 50-59
   - ☐ 60-69
   - ☐ 70 +

Section 2 - Lecture Experience

1. **How many times have you taught <course code> before?**
   - ☐ 0
   - ☐ 1-2
   - ☐ 3-5
   - ☐ 6-10
   - ☐ 11+

2. **How many other university level courses have you taught before?**
   - ☐ 0
   - ☐ 1-2
   - ☐ 3-5
   - ☐ 6-10
   - ☐ 11+

3. **Considering your allotted lecture time for <course code>, which statement below best applies to you?**
   - ☐ My lectures(s) typically end early.
   - ☐ My lectures(s) typically end on time.
   - ☐ My lectures(s) typically go past the scheduled class time.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
4. I prepare for my lectures by:					
a. Knowing how much time all my intended lecture material will take.	☐	☐	☐	☐	☐
b. Knowing how much time sections of my lecture will take. *(e.g., I should be at slide X halfway through my lecture time, topic Y should take 2 minutes).*	☐	☐	☐	☐	☐
c. Knowing what sections of my lecture to skip in case I am short on time.	☐	☐	☐	☐	☐
d. Knowing what lecture material to add in case I have extra time.	☐	☐	☐	☐	☐
5. During the actual lecture, I typically find myself:					
a. Spending too much time on specific lecture material.	☐	☐	☐	☐	☐
b. Skipping lecture material.	☐	☐	☐	☐	☐
c. Rushing through lecture material.	☐	☐	☐	☐	☐
d. Adding more (unplanned) lecture material on the spot.	☐	☐	☐	☐	☐
e. Getting ahead of schedule. *(i.e., covering lecture material originally planned for future classes)*	☐	☐	☐	☐	☐
6. When lecturing, getting through all my intended lecture material is important to me.	☐	☐	☐	☐	☐
7. I am confident in my abilities to lecture.	☐	☐	☐	☐	☐
8. I am confident in my abilities to end my lectures on time.	☐	☐	☐	☐	☐

Section 3 - Use of Timing Aids

1. **Do you use any form(s) of timing aids (*e.g., a wristwatch, laptop timer, phone, wall clock*) to help you keep track of how much time is left while you lecture?**

   ☐ Yes
   ☐ No

   *If **No**, please answer the following:*

   i. Why do you NOT use any timing aids? *Check all that apply.*
      ☐ Keeping track of time is not one of my responsibilities.
      ☐ Timing aids distract me when I am lecturing.
      ☐ Timing aids make me nervous when I am lecturing.
      ☐ I have a timing aid, but forget to use it when I am lecturing.
      ☐ I have prepared for my lecture enough and know I will end on time.
      ☐ Other: *(please specify)* _____

   ii. How are you ensuring your lecture ends on time? *Check all that apply.*
      ☐ Ensuring a timely lecture is not one of my responsibilities.
      ☐ I know my lecture will end on time due to preparation.
      ☐ I rely on the students to tell me if I am out of time. *(e.g., packing up their bags)*
      ☐ Other: *(please specify)* _____

   *Then skip to **Section 4**.*

2. **What form(s) of timing aid do you use to help you keep track of the time while you lecture? *Check all that apply.***
   ☐ Wristwatch
   ☐ Computer timer (e.g., laptop clock)
   ☐ Presentation software timer (e.g., Microsoft PowerPoint timer)
   ☐ Cellphone or smartphone
   ☐ Venue provided timing aid (e.g., wall clock)
   ☐ Other: *(please specify)* _____

3. **Timing Aid:**

   a. **Name the timing aid you use *most* when lecturing** *(e.g., iPhone clock)*

   _____

For the remaining questions on this page, please answer with respect to the timing aid you specified in Question <#>.

   b. **How do you use this timing aid to keep track of the time?** *Check all that apply.*
      ☐ I start a *countdown* timer at the beginning of my lecture.
      ☐ I start a *stopwatch* timer at the beginning of my lecture.
      ☐ While lecturing, I look at the *current time* to see how much time I have left.
      ☐ I set a *silent alarm* to notify me when my time is up. *(e.g., cellphone in pocket)*
      ☐ Other: *(please specify)* _____

   c. **What do you like about this timing aid?** *Check all that apply. Leave blank if none.*
      ☐ It is reliable.
      ☐ It is simple to use.
      ☐ It is easy to refer to.
      ☐ Its timing information is easy to understand.
      ☐ Its timing information is easy to notice.
      ☐ It automatically notifies me of important time reminders.
      ☐ Other: *(please specify)* _____

   d. **What do you dislike about this timing aid?** *Check all that apply. Leave blank if none.*
      ☐ It is unreliable.
      ☐ It is distracting.
      ☐ It is difficult to use.
      ☐ It is difficult to refer to.
      ☐ Its timing information is difficult to understand.
      ☐ Its timing information is easy to miss.
      ☐ It requires me to manually refer to it in order to keep track of the time.
      ☐ Other: *(please specify)* _____

   e. **How would you improve the way this timing aid helps you keep track of time while lecturing?** *Leave blank if none.*

   _____

f. For this timing aid, please check one for each of the following:

As a lecturer, I …	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Rely on this timing aid to keep track of the time.	☐	☐	☐	☐	☐
2. Easily notice important time reminders from this timing aid while lecturing.	☐	☐	☐	☐	☐
3. Am able to focus on lecturing when using this timing aid.	☐	☐	☐	☐	☐
4. Am satisfied with this timing aid in helping me keep track of time.	☐	☐	☐	☐	☐

Section 4 - Haptic Reminders Study – Personal Lecture Reminders

Please answer each of the following with regards to the lecture you will be giving for the study.

1. **Based on your lecture length, if you could decide *when* you would like to be reminded of the time, when would these reminders take place?**

   Please **list** on the lines below following these formats (*you may list as many as you like*):

   - *'X* minutes in' *(e.g., 10 minutes into my lecture)*
   - *'X* minutes left' *(e.g., 5 minutes until my time is up)*
   - Halfway through
   - When my time is up

   _____
   _____
   _____
   _____
   _____

2. **What additional reminders would you like during your lecture?**

   Here are some examples:

   - When I have reached slide X
   - When I have reached topic X
   - When I have spent X minutes on one topic / slide
   - When a student has a question

   _____
   _____
   _____
   _____
   _____

Section 5 - Additional Comments

What additional comments do you have about lecturing, timing or reminders?

_____
_____
_____
_____
_____
_____

Thank you for your participation!

C.7 Class Lecture (Post-Study)

Exploring Presentation Timing Through Haptic Reminders
LECTURER POST-STUDY QUESTIONNAIRE

Please take a few minutes to answer the following questions. This questionnaire will further inform design implications for haptic reminders that may improve the quality and timeliness of future lectures.

Thank you again for your co-operation.

Name *(First Last)*: _____

Section 1 - Lecture Experience

1. **Please select your lecture session from the following list:**
   <dropdown list of lecture sessions>

2. **Were you able to finish this lecture within your allotted class time?**
   - ☐ Yes, I finished with time to spare.
   - ☐ Yes, I finished on time.
   - ☐ No, I went over time.
   - ☐ I don't know.

3. **Did you have to skip over any lecture content due to timing constraints?**
   - ☐ No
   - ☐ Yes, I skipped a little bit of content.
   - ☐ Yes, I skipped a lot of content.
   - ☐ I don't remember.

4. **Did you have to rush through any lecture content due to timing constraints?**
   - ☐ No
   - ☐ Yes, I rushed through a little bit of content.
   - ☐ Yes, I rushed through a lot of content.
   - ☐ I don't remember.

5. **While lecturing, did you add any unplanned content to your lecture on the spot?**
   - ☐ No
   - ☐ Yes, I added a little bit of unplanned content.
   - ☐ Yes, I added a lot of unplanned content.
   - ☐ I don't remember.

6. **While lecturing, did you find yourself getting ahead of schedule? (i.e., covering lecture material originally planned for future classes)**
   - ☐ No
   - ☐ Yes, I covered a little bit of new content.
   - ☐ Yes, I covered a lot of new content.
   - ☐ I don't remember.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
7. I prepared for my lectures by:					
a. Knowing how much time all my intended lecture material will take.	☐	☐	☐	☐	☐
b. Knowing how much time sections of my lecture will take. (e.g., I should be at slide X halfway through my lecture time, topic Y should take 2 minutes).	☐	☐	☐	☐	☐
c. Knowing what sections of my lecture to skip in case I am short on time.	☐	☐	☐	☐	☐
d. Knowing what lecture material to add in case I have extra time.	☐	☐	☐	☐	☐
8. I am satisfied with the overall pace of my lecture. *(e.g., the amount of time spent on each section of the lecture)*	☐	☐	☐	☐	☐
9. Overall, my lecture went well.	☐	☐	☐	☐	☐

Section 2 - Haptic Reminders

1. **Did you wear the Haptic Reminder device during this lecture session?**
   - ☐ Yes
   - ☐ No

*If you answered **Yes**, please proceed to **Section 2 - Question 2.***
*If you answered **No**, please proceed to **Section 4.***

2. Haptic Reminders

For your lecture, you were given the following reminders:

- <list of reminders>

a. What do you like about the haptic reminder device? *Check all that apply. Leave blank if none.*

- ☐ It is reliable.
- ☐ It is simple to use.
- ☐ I can easily refer to it
- ☐ Its reminders are easy to understand.
- ☐ Its reminders are easy to notice.
- ☐ It automatically notifies me of important reminders.
- ☐ Other: *(please specify)* _____

b. What do you dislike about the haptic reminder device? *Check all that apply. Leave blank if none.*

- ☐ It is unreliable.
- ☐ It is difficult to use.
- ☐ It is difficult to refer to.
- ☐ Its reminders are distracting.
- ☐ Its reminders are difficult to understand.
- ☐ Its reminders are easy to miss.
- ☐ Other: *(please specify)* _____

c. How did the haptic reminders help you the most during this lecture?

_____

d. Was it difficult to remember what the haptic reminders meant while lecturing?

- ☐ Yes
- ☐ No

e. If you answered YES above, why was it difficult? *Check all that apply.*

- ☐ It was difficult to remember each reminder based on the haptic stimuli mapping alone. *e.g., A slow gradual reminder means that X minutes is left, a strong haptic reminder implies urgency or importance.*
- ☐ I was trying to remember the reminders based on the order they occurred but I lost track while lecturing. *(e.g., First reminder is the X minute reminder, Second reminder is the Y minute reminder, etc…)*
- ☐ Other: *(please specify)* _____

f. If you answered NO above, what helped you remember what each haptic reminder meant? *Check all that apply.*

- ☐ The haptic stimuli mapping. *e.g., 'X minutes left' was associated with a slow gradual reminder, an urgent or important reminder was associated with a strong haptic reminder.*
- ☐ The order of the reminders. *e.g., First reminder is the X minute reminder, Second reminder is the Y minute reminder, etc…*
- ☐ Other: *(please specify)* _____

g. Are you satisfied with the haptic reminders? If **NO**, how would you change them? *(e.g., changes to the interval, frequency, stimuli, or meaning of the reminders, have additional reminders…) Leave blank if none.*

_____

h. Please check one for each of the following:

As a lecturer, I …	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Relied on the haptic reminders to keep track of the time.	☐	☐	☐	☐	☐
2. Am satisfied with the haptic reminders in helping me keep track of time.	☐	☐	☐	☐	☐
The haptic reminders…					
3. Allowed me to focus on lecturing, without monitoring the time myself.	☐	☐	☐	☐	☐
4. Were not distracting.	☐	☐	☐	☐	☐
5. Were easy to understand.	☐	☐	☐	☐	☐
6. Were easy to notice.	☐	☐	☐	☐	☐
The haptic reminder device …					
7. Was easy to interact with.	☐	☐	☐	☐	☐
8. Would be useful to me for a future lecture.	☐	☐	☐	☐	☐
9. Is better than my usual timing aids in helping me keep track time.	☐	☐	☐	☐	☐

Section 3 - Use of Timing Aids

1. **In addition to the Haptic Reminders, did you use another form of timing aid *(e.g., a wristwatch, laptop timer, phone, wall clock)* to help you keep track of the time while lecturing?**
   - ☐ Yes
   - ☐ No

   *If you answered **Yes**, please proceed to **Section 3 - Question 2**.*
   *If you answered **No**, please proceed to **Section 5**.*

2. **What form(s) of timing aid did you use to help you keep track of the time while lecturing? *Check all that apply.***
   - ☐ Wristwatch
   - ☐ Computer timer (e.g., laptop clock)
   - ☐ Presentation software timer (e.g., Microsoft PowerPoint timer)
   - ☐ Cellphone or smartphone
   - ☐ Venue provided timing aid (e.g., wall clock)
   - ☐ Other: *(please specify)* _____

3. **Timing Aid**
   a. **Name the timing aid you used most when lecturing** *(e.g., iPhone clock)*

   _____

For the remaining questions on this page, please answer with respect to the timing aid you specified in Question <#>.

   b. **Why did you use this timing aid even though you were already wearing the Haptic Reminder device?** *Check all that apply.*
      - ☐ I wanted a backup timing aid just in case I missed the haptic reminders.
      - ☐ I wanted a backup timing aid just in case I had trouble using the haptic reminder device.
      - ☐ I wanted a backup timing aid just in case I had trouble understanding the haptic reminders.
      - ☐ I wanted additional timing information available to me while lecturing.
      - ☐ I wanted to use my own timing aid to keep track of the time while lecturing.
      - ☐ Other: *(please specify)* _____

   c. **How did this timing aid help you the most during this lecture?**

   _____

   d. **What features of this timing aid would help improve your use of the Haptic Reminder device while lecturing?**

   _____

Section 4 - Use of Timing Aids

1. **Did you use any form(s) of timing aids *(e.g., wristwatch, laptop timer, phone, wall clock)* to help you keep track of the time while lecturing?**
   - ☐ Yes
   - ☐ No

   *If you answered **Yes**, please proceed to **Section 4 - Question 2**.*
   *If you answered **No**, please proceed to **Section 5**.*

2. **What form(s) of timing aid did you use to help you keep track of the time while lecturing? *Check all that apply.***
   - ☐ Wristwatch
   - ☐ Computer timer (e.g., laptop clock)
   - ☐ Presentation software timer (e.g., Microsoft PowerPoint timer)
   - ☐ Cellphone or smartphone
   - ☐ Venue provided timing aid (e.g., wall clock)
   - ☐ Other: *(please specify)* _____

3. **Timing Aid:**
   a. **Name the timing aid you used most when lecturing** *(e.g., iPhone clock)*

   _____

For the remaining questions on this page, please answer with respect to the timing aid you specified in Question <#>.

   b. **How did you use this timing aid to keep track of the time?** *Check all that apply.*
      - ☐ I started a *countdown* timer at the beginning of my lecture.
      - ☐ I started a *stopwatch* timer at the beginning of my lecture.
      - ☐ While lecturing, I looked at the *current time* to see how much time I had left.
      - ☐ I set a *silent alarm* to notify me when my time was up. *(e.g., cellphone in pocket)*
      - ☐ Other: *(please specify)* _____

c. What do you like about this timing aid? *Check all that apply. Leave blank if none.*

- ☐ It is reliable.
- ☐ It is simple to use.
- ☐ It is easy to refer to.
- ☐ Its timing information is easy to understand.
- ☐ Its timing information is easy to notice.
- ☐ It automatically notifies me of important time reminders.
- ☐ Other: *(please specify)* _____

d. What do you dislike about this timing aid? *Check all that apply. Leave blank if none.*

- ☐ It is unreliable.
- ☐ It is distracting.
- ☐ It is difficult to use.
- ☐ It is difficult to refer to.
- ☐ Its timing information is difficult to understand.
- ☐ Its timing information is easy to miss.
- ☐ It requires me to manually refer to it in order to keep track of the time.
- ☐ Other: *(please specify)* _____

e. How did this timing aid help you the <u>most</u> during this lecture?

_____

f. How would you improve the way this timing aid helps you keep track of time while lecturing? *Leave blank if none.*

_____

g. For this timing aid, please check one for each of the following:

As a lecturer, I …	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Relied on this timing aid to keep track of the time.	☐	☐	☐	☐	☐
2. Easily noticed important time reminders from this timing aid while lecturing.	☐	☐	☐	☐	☐
3. Was able to focus on lecturing when using this timing aid.	☐	☐	☐	☐	☐
4. Am satisfied with this timing aid in helping me keep track of time.	☐	☐	☐	☐	☐

<u>Section 5 - Additional Comments</u>

What additional comments do you have in regards to your experience with the haptic reminder device, or your overall experience with timing or reminders during this lecture?

_____
_____
_____
_____
_____
_____

Thank you for your participation!

C.8 Class Lecture (Post-Study Interview)

Exploring Presentation Timing Through Haptic Reminders
LECTURER POST-INTERVIEW QUESTIONS

Name *(First Last)*: _____

Section 1 — Haptic Reminders

1. **Please briefly answer the following:** ***Leave blank if not applicable.***

   i. What interested you most about wearing the haptic reminder device while lecturing?

   ii. Did you have any concerns in regards to wearing the haptic reminder device while lecturing?

   iii. Did you have a preference over which wrist (left vs right) to wear the device on? If so, why? (e.g., left or right handed)

   iv. How did the haptic reminders help you the most as a lecturer?

   v. What do you like about the haptic reminders?

   vi. What do you dislike about the haptic reminders?

   vii. How would you improve the haptic reminders?

   viii. How would you improve the haptic reminder device?

   ix. How would you improve the interaction with the haptic reminder device?

   x. How else would haptic reminders be useful to you as a lecturer?

   xi. How would you want haptic reminders integrated into the classroom? (e.g., implemented in iClickers, presentation software, etc…)

   xii. Would you use the haptic reminder device again in future lectures?

Section 2 — Use of Timing Aids

1. **For the timing aid you used the most <*gathered from post-questionnaires*>, please describe briefly the following:** ***Leave blank if not applicable.***

   i. How do you typically manage your time in the classroom?

   ii. How did your timing aid help you stay aware of the time?

   iii. What do you like about the timing aid?

   iv. What do you dislike about the timing aid?

v. What features of this timing aid would help improve your use of the Haptic Reminder device while lecturing? (i.e., only use the Haptic Reminder device without the additional timing aid)

_____

Section 3 — Additional Comments

Do you have any additional comments in regards to your experience with the haptic reminder device, or your overall experience with timing or reminders while lecturing?

_____
_____
_____
_____
_____
_____

Thank you for your participation!