TalkZones: Section-based Time Support for Presentations

Bahador Saket[1,2], Sijie Yang[1,3], Hong Tan[1], Koji Yatani[1], Darren Edge[1]
[1] Microsoft Research, Beijing, China
[2] University of Arizona, Arizona, USA
[3] Indiana University, Bloomington, Indiana, USA
saket@email.arizona.edu, y1s2j3@gmail.com, {hongtan, koji, darren.edge}@microsoft.com

ABSTRACT
Managing time while presenting is challenging, but mobile devices offer both convenience and flexibility in their ability to support the end-to-end process of setting, refining, and following presentation time targets. From an initial HCI-Q study of 20 presenters, we identified the need to set such targets per "zone" of consecutive slides (rather than per slide or for the whole talk), as well as the need for feedback that accommodates two distinct attitudes towards presentation timing. These findings led to the design of TalkZones, a mobile application for timing support. When giving a 20-slide, 6m40s rehearsed but interrupted talk, 12 participants who used TalkZones registered a mean overrun of only 8s, compared with 1m49s for 12 participants who used a regular timer. We observed a similar 2% overrun in our final study of 8 speakers giving rehearsed 30-minute talks in 20 minutes. Overall, we show that TalkZones can encourage presenters to advance slides before it is too late to recover, even under the adverse timing conditions of short and shortened talks.

Author Keywords
Presentations; Timing; Pacing; HCI-Q Methodology

ACM Classification Keywords
H.5.2. Information interfaces and presentation: User Interfaces

INTRODUCTION

Oral presentations often have predefined time limits that speakers should not exceed out of respect for the audience's time and the following schedule of events. However, the cognitive challenges of dividing attention with the secondary pacing task [11, 31] and the social pressure of maintaining a level of engagement with the audience [1, 3, 7, 8] mean that presenters may not be able to fully attend to their timing while they are speaking. Previous approaches to presentation timing support [17, 26] have also failed to control talk pacing and time overruns adequately. We believe that mobile devices offer a particularly flexible, practical, and contextually-appropriate channel through which to configure and follow talk timing support. Our goal with this research is thus to explore how a mobile application could support all stages of the presentation time management process, from planning and refinement to rehearsals and delivery.

MobileHCI'14, September 23 - 26 2014, Toronto, ON, Canada
Copyright 2014 ACM 978-1-4503-3004-6/14/09…$15.00.
http://dx.doi.org/10.1145/2628363.2628399

We begin by reviewing the related work from the cognitive science literature on pacing, planning, and split attention; the presentation literature on best practices; and presentation systems in the HCI literature and the marketplace. Through this review, we derive a set of concerns that should be considered when designing for timing support.

Next, we describe how we used HCI-Q methodology [20] to elicit presenter feedback on these potential concerns. We translated these concerns into concrete statements of potential stakeholder perspectives, before using these statements as the basis of the card sort (N=20). This helped to characterize contrasting attitudes towards timing based on the level of flexibility of the presenter-timing relationship:

- **Less-flexible attitude:** the presenter wants to stay in control in a well-rehearsed talk, using a glanceable countdown against coarse, well-tested time targets.
- **More-flexible attitude:** the presenter wants to finish on time in a more-improvised talk, following adaptive guidance based on fine-grained, aspirational time targets.

This re-examination of presenter attitudes towards timing support helped us understand why existing approaches might not be optimal. For example, setting a single time target for the whole talk cannot provide adequate pacing information early in the talk (when there is still time to get back on track). Conversely, setting time targets for each individual slide can result in feedback that overemphasizes the importance of following a timing plan precisely (at the expense of other metrics like fluency of slide transitions). Our high-level conclusion and contribution is that planning and following time targets for *zones of slides*, rather than for individual slides or for the whole talk, allows presenters to prepare the timing plan for each talk at the level of detail it requires.

In the design section, we describe our resulting TalkZones prototype: a mobile application that supports flexible target setting for zones of consecutive presentation slides. This mobile application acts as a companion to presentation slideware, supporting time management throughout presentation planning, rehearsal, and delivery. Motivated by the results of our analysis, TalkZones supports customization of the timing feedback visualization along two axes:

- **Target type:** whether time targets are shown as they were *planned* (less-flexible) or targets that are *adaptive* to current progress and time remaining (more-flexible).
- **Detail level:** whether visual feedback is shown for the talk *overall* (less-flexible) or just for the current *zone* emphasizing the immediate situation (more-flexible).

Our evaluation of TalkZones spans two related studies. The first is a between-subjects study (*N*=24) of TalkZones against a regular timer, with participants in the TalkZones condition following a structured elicitation of configuration preferences under various scenarios. In most situations, the majority of TalkZones users would choose our *adaptive-overview* visualization of timing feedback. This visualization combines elements designed for both less-flexible and more-flexible attitudes towards presentation timing, suggesting that it is a satisfactory solution in general. The next task was to deliver a rehearsed 6m40s talk using a deck of 20 slides, each prompting the speaker to describe an aspect of their life. In addition to giving a short talk with many slides, the time pressure was increased further through four interruptions (emulating questions from the audience) in both conditions. All 12 participants in the TalkZones condition used the *adaptive-overview* visualization with 2-5 zones (mode of 4). The mean and maximum overruns were 8s (2% over time) and 35s (9%), compared with 1m49s (27%) and 3m40s (55%) in the control condition using a regular timer. TalkZones thus provides effective timing support for short presentations, even when they are shortened by interruptions.

In our second study (*N*=8), presenters pre-rehearsed 30-minute talks with their own slides before starting the session. At the beginning of the session, we instructed them that the time limit had been shortened from 30 to 20 minutes, and that they could use TalkZones with the *adaptive-overview* visualization to manage their timing. Results were almost identical to the first study: all participants created 3-5 zones (mode of 4) leading to well-controlled mean and maximum overruns of 23s (2% over time) and 2m3s (10%). TalkZones thus provides effective timing support for medium-length presentations, even when the talk is shortened in an unanticipated manner. Overall, we also learned that 4 zones represent a manageable number of opportunities to receive and act upon late signals for a range of talk durations.

RELATED WORK

In this section, we move from general results in cognitive science, via recommendations of best presentation practices, towards concrete systems for presentation timing support. Significant concerns are emphasized with italics.

Cognitive Science Literature

Punctuality in oral presentations is always desired, yet often difficult to achieve. Psychological studies have observed *distortion of time perception* during cognitively-demanding tasks, with people overestimating the passage of time [11]. The attentional-gate model attempts to explain this phenomenon through the *division of attentional resources* between the main task and the secondary task of time tracking [31]. Since the cognitive workload of the main task of delivering presentations is very high, there is often starvation of attention for the secondary task of time tracking. This is especially pronounced for inexperienced presenters, as well as for those anticipating failure or unpleasantness because of *communication apprehension* [2].

Another possible explanation for unsuccessful time tracking during presentations, even for seasoned presenters, is the planning fallacy [14]. The tendency to adhere to an original timing assessment and ignore the potential impact of unanticipated factors on the actual completion time (as shown in [6]) can result in a *distortion of time estimation*. Frequent comparison of actual-to-planned progress, especially in rehearsal, could help to ameliorate this bias.

Timing notifications should not be disruptive to the main task since excessive interruptions can lead to degradation of task completion efficiency [15] and emotional state [4]. The complexity of the interrupting task and its similarity to the main task both impact a person's ability to switch back again [13]. This suggests that *unimodal interference* between audio notifications and the presenter's speech process should be avoided, and that *multimodal notifications* [29], for instance using the haptic channel [26], should be preferred.

Presentation Advice

Presentation expert Nancy Duarte provides several strategies for keeping to time [8]. The first two steps are to "Plan content for 60% of your time slot" and "Trim your slide deck" by moving non-essential slides to an appendix, which we can summarize as *authoring to time limits*. The next step is to "Practice with the clock counting up", first cutting slides to meet the time limit and then iterating until rehearsals consistently fall within the time limit. This is followed by "Practice with the clock counting down" – dividing presentation content into quarters and assigning cumulative time markers to the slides as targets. Such *rehearsing to time targets* could help presenters refine their timing plan into a more fine-grained and accurate guide for the final delivery. Duarte also recommends *preparing to shorten* to guard against talk overruns: plan a shorter version of the talk with the same material or have two natural ending points [8].

One structured approach to *preparing to shorten* is to use the Beyond Bullet Points [3] presentation template, organized hierarchically with Key Point slides, Explanation slides, and Detail slides. While presenting all slides might take 45 minutes, hiding all the Detail slides might shorten the talk to 15 minutes, and presenting only the introduction and Key Point slides might take just 5 minutes. A related strategy for more freeform presentations is *timing by the section* such that if the talk needs to be shortened, the presenter can more easily determine which sections to cut to finish on time [1].

In a timed presentation, *monitoring time while speaking* is important because it is all too easy to lose track of time without any external reference [7]. A large clock on the lectern, a wall clock, or a signaling audience member all enable discrete time checks in ways that are preferable to reading the time from a watch, which "sends the unspoken message that you are either bored or anxious to bolt" [7]. Monitoring time also enables *communicating time plans and progress*, letting the audience know that you are sensitive to time constraints and the value of their time in ways that help to build rapport and maintain audience attention [7].

Presentation Systems

Mamykina et al. [17] were the first researchers to address presentation timing. They describe several problems with using conventional timing tools, such as watches and timers, for pacing tasks: the numeric display is not designed for glanceability (or *preattentive processing* – the unconscious detection of basic visual information [27]); mental resources are consumed by *proactive time checking* and the *calculation of relative progress*; and any *disruption to the prior plan* must be mentally tracked and accommodated in real-time. They then draw on several theories from the behavioral sciences to propose five design goals for pacing interfaces:

1. Minimize cognitive load for regulating a dynamic task.
2. Provide information on the progress of the task.
3. Indicate discrepancies between planned and actual pace.
4. Lead to an optimal recovery strategy.
5. Require less effort than the task being augmented.

Translating these goals into pacing features, they suggest pacing interfaces should include a *task overview*, a *progress report*, *pacing cues*, and *control over the task*. Their resulting Time Aura system [17] uses an *ambient display* [22, 30] to achieve these goals, minimizing the cognitive cost of *detecting and correcting plan deviations*. It comprises a modified slide list at the side of the presenter's private view to communicate progress (Figure 1). Slides are represented at heights proportional to their *slide time target* such that the whole talk fills the height of the screen. An *elapsed time marker* continuously descends along a vertical time-line and a *current slide highlight* moves discretely with advancing slides, with the spatial distance between the two communicating the difference between planned and actual progress. A redundant representation of the pace difference is provided by color interpolation of a transparent slide list overlay (blue=ahead, white=on-time, red=behind).

In an informal, between-subject study of 9 participants presenting ready-made slides according to a predetermined timing plan and 7-minute time limit, presentations with Time Aura resulted in a significantly higher subjective evaluation of pacing as rated by the audience (although no times were reported). Mamykina et al. also observed that the system divided visual attention between the audience, speaking notes, and timing cues, suggesting use of *multimodal cues*. Their conclusion was that future systems should provide *flexible and customizable interfaces* that support a range of *compensatory strategies* (e.g., slide skipping, revisitation), as well as *forgiving feedback* that does not cause presenter alarm when deviations from the timing plan are correctable.

In the second main work on presentation timing support, Tam et al.'s HaNS [26] is a wrist-worn haptic notification system that uses three 10-second *symbolic vibration patterns* to communicate *increasingly urgent notifications* that the talk time is almost up (e.g., 3 minutes, 1 minute, and 0 minutes). It also incorporates a private channel for *session chair communication*, with chair-initiated overtime signals that can be covertly acknowledged by the presenter.

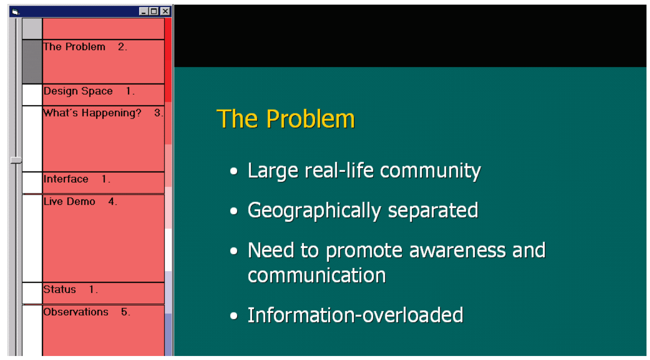

Figure 1. Time Aura pacing interface [17]

Results of field observations at three mid-sized speaking events (where presenters were still free to use their own tools and strategies for time control) indicate that such a haptic notification system can deliver salient cues through *unobtrusive and private notifications* while *minimizing social implications* of chair-speaker timing exchanges. However, speakers using HaNS still went overtime: at one event, 43% (10/23) of speakers opting to use HaNS overran by a mean 51s. At the same event, 45% (9/20) of non-HaNS speakers overran by a mean 32s. Nevertheless, speakers were observed responding to haptic cues by adjusting their pace accordingly. This suggests that *customizable cue timings* and *early indications of lateness* could enhance presenters' time control. The wearable form factor allowed presenters to *leave the lectern* and roam freely, unlike Time Aura [17].

In our prior study on understanding presentation practices [10], we identified *influencing audience with timing* as a major concern for presenters. Informants reported problems associated with interruptions, slide skipping, underrunning, overrunning, and being cut off, all in ways that were perceived to betray nervousness, nonchalance, or inadequate preparation. Our HyperSlides system [10] supports dynamic prototyping of semantically hyperlinked slides through the hierarchical specification of talk structure. The associated approach to time management is to reduce the number of points that are expanded by choosing not to drill down the slide hierarchy. The audience thus remains unaware that the presenter needed to skip some prepared materials, *maintaining speaker credibility*. Another system that uses *non-linear slide paths* as a compensatory strategy is NextSlidePlease [25]. The user first assigns time costs to slides organized in a directed graph, then during delivery the optimum path to timely completion is continuously updated.

We have also previously explored the connection between the activities of rehearsal and time planning. Our PitchPerfect [28] system supports *authoring to time limits* and *rehearsing to time targets* as recommended in the literature. Voice-activated recording and timing also aims to reduce the feelings of anxiety and time pressure resulting from continuous recording of all pauses and mistakes. This conforms to the common strategy of *reducing notes, times, and errors until ready*, and emphasizes the importance of tracking timing progress throughout the rehearsal process.

The marketplaces for mobile applications also contain many examples of *remote controllers* for desktop slideware, which typically use simple indicators tied to slide progress and the elapsed or remaining time (e.g., the Office Remote mobile app for controlling Microsoft PowerPoint [19]). Timing-oriented tools typically offer richer feedback through visualizations and audio and haptic feedback, as well as customizable notification schedules, but without any coupling to slide progress. The *physical comfort* and *social perception* of using a handheld mobile device while presenting also depends on the nature of the talk event.

UNDERSTANDING ATTITUDES TO TIMING SUPPORT

We wanted to understand the importance that potential users of presentation timing support would assign to the various concerns we derived from our literature review, as well as the existence of conflicting attitudes that might arise from differences in presenter personality or talk situation.

We decided to adopt HCI-Q methodology [20] for this purpose since it aligned closely with our study requirements. Firstly, HCI-Q tailors the well-established Q-methodology to solicit stakeholder feedback prior to designing or building any particular system, allowing critical reflection on basic assumptions and avoiding premature prototyping and fixation on preconceived solutions. Secondly, HCI-Q can lend statistical validity (and potential replication) to the qualitative interpretation of subjective data taken from small samples, generating groupings of stakeholder attitudes that provide a strong basis for the crafting of design requirements.

The methodology is based on a Q-Set – a balanced collection of positive and negative statements crafted by designers to represent possible stakeholder attitudes. Explicitly considering the negative implications of a design allows for critical reflection on the impact it could make on people's lives [9]. The complementary Q-Sort involves stakeholders sorting those statements into a forced distribution. Factor analysis then reveals the statistically quantifiable set of underlying perspectives that can be used to ground design.

Participants

We recruited 20 stakeholders from our organization (11 male and 9 female, ages 21–50), with backgrounds in computer science, engineering, design, and marketing and communication. All had experience giving timed talks at formal academic conferences or business events.

Procedure

Our HCI-Q analysis used a Q-Set of 30 concrete statements pertaining to presentation timing support, directly mapped from the more abstract set of concerns we derived from our literature review. The Q-Sort itself was performed with FlashQ [12] and comprised two stages. In the first stage, informants read each statement, asked the experimenter for further explanations if necessary, then provisionally assigned the statement to one of three groups: agree, neutral, and disagree. This familiarized the informant with all statements and began the process of differentiation.

Figure 2. Example Q-Sort of statements into a forced distribution from most disagree (left) to most agree (right). Colors indicate initial assignments of statements to agree (green), disagree (red), and neutral (grey) groups.

In the second stage, informants arranged all statements in a forced distribution table according to the personal significance of the statements in their own experiences. Our table consisted of columns representing 9 ordinal levels of agreement from most disagree to most agree, with 2-3-3-4-6-4-3-3-2 rows of statements respectively. This relatively flat distribution is appropriate when informants are knowledgeable about the subject matter and thus likely to have stronger feelings [5], as was the case with our presenters. Figure 2 shows an example Q-Sort result from one study informant. After completing the Q-Sort, each informant explained their ratings to the experimenter.

Following our HCI-Q sessions with stakeholders, we used the PQMethod tool [23] to analyze the data. Principal Component Analysis extracted 8 factors from which we chose the two factors that explained the greatest variance in the data (21% and 17% compared with 9% and below). Rotation revealed the two factors A and B to be defined by 9 and 11 stakeholders respectively, with no confounds.

Results

The final result is a model Q-Sort for each of Factor A and B that defines the attitudes of a prototypical stakeholder in a way that can inform design. Each factor contains a similar distribution of experience levels for its defining stakeholders. The characterization of both Factor A and Factor B across the 30 statements in our Q-Set is shown in Tables 1 and 2.

Consensus & Conflict between Factors

Table 1 shows that stakeholders in both factors strongly agree that sound-based feedback is likely to be distracting, and in interviews informants reported several bad experiences with audio alerts built into some applications and conference facilities. More surprisingly, both factors strongly disagreed that presentation software should help presenters cover all of the prepared materials without skipping slides or rushing. Interview responses clarified that presenters should always retain the freedom to adjust their pacing as they feel is appropriate (including slide skipping if required), using timing feedback as a guide rather than a rule.

Factor	Agreement	Statement	Z-score
A	Strongly Agree	*Sound-based timing feedback would be distracting for the presenter or the audience or both.*	*1.8*
		*It should not feel like an emergency or like I have failed if I don't quite hit my time targets.	1.6
		*When there is a time limit for the presentation, it is more important to know the time remaining than the time spent so far.	1.3
		*It is often not socially appropriate to hold a mobile phone while giving a presentation.	1.2
		*I would not use presentation timing support in a live presentation without using it in rehearsals beforehand.	1.1
		*Visual timing feedback should be quickly glanceable even from a distance and focus on essential information only.	1.1
		***I would not use physical timing feedback (e.g., a vibrating phone or wristband) if it had the potential to surprise me.**	1.1
		*It is often physically uncomfortable to hold a mobile phone while giving a presentation	0.9
	Strongly Disagree	*Timing feedback should become harder to ignore if the presenter is in danger of running behind and time is running out.	-1.8
		*I would use physical timing feedback (e.g., a vibrating phone or wristband) because I would not have to remember to check the time.	-1.8
		***When presentations have a time limit, presentation software should help presenters to finish within the allowed time.**	-1.2
		*I would like to receive timing feedback on a handheld mobile device I also use to control my slides.	-1.1
		*Presentation timing support should help me anticipate when I should move to the next slide so I can move on accordingly.	-1.1
		***Timing support should help the presenter adapt to any unexpected changes to the time limit before or during the talk.**	-1.0
		Presentation software should help presenters to cover all of the prepared material without skipping slides or rushing.	*-1.0*
B	Strongly Agree	***When presentations have a time limit, presentation software should help presenters to finish within the allowed time.**	2.0
		*During a presentation, timing support should adjust time targets based on actual progress rather than targets planned in advance.	1.6
		Sound-based timing feedback would be distracting for the presenter or the audience or both.	*1.4*
		***Timing support should help the presenter adapt to any unexpected changes to the time limit before or during the talk.**	1.3
		Getting better at meeting time targets during rehearsal would improve my timekeeping and confidence for the live presentation.	1.3
	Strongly Disagree	*I am concerned that feedback from a tool may be more noticeable to the audience than signals from a session chair.	-2.1
		***I would not use physical timing feedback (e.g., a vibrating phone or wristband) if it had the potential to surprise me.**	-1.8
		*I would not be willing to use timing feedback if I had to think about how long I wanted to spend on each slide.	-1.8
		Presentation software should help presenters to cover all of the prepared material without skipping slides or rushing.	*-0.9*
		*I am concerned that continuous timing feedback could make me nervous and result in a poorer performance than without it.	-0.8

Table 1. Results of HCI-Q analysis characterizing two factors at a strong dis/agreement level (|*Z*|>0.8). Positive consensus is shown in green/italic, negative consensus in red/italic and conflict in blue/bold. Starred statements distinguish factors at significance *p*<.01.

Remaining 10 statements that do not distinguish Factor A and Factor B at significance level $p < .01$	Z-score		
	A	B	A-B
I would prefer to check my timing when it is convenient rather than risk being distracted by automatic notifications.	0.04	-0.73	0.8
I would be concerned that the mental load of interpreting timing feedback would be greater than mentally tracking my own progress.	0.02	-0.71	0.7
Use of presentation timing support should not be apparent to the audience since it could erode the credibility of the speaker.	0.61	0.39	0.2
I would not want to do any kind of mental calculation to work out whether I should move on or keep talking about the same slide.	0.05	-0.05	0.1
I would typically want my timing feedback to include a numeric representation of the total time spent so far or time remaining.	0.17	0.18	0.0
Rehearsing a presentation should have the beneficial side effect of helping me to set time targets for the final delivery.	0.44	0.56	-0.1
It is more realistic to plan to finish a talk within a certain time window (e.g., 15-18 minutes) than after a precise time.	-0.27	0.21	-0.5
Presenters should always try to finish on time even if they are frequently interrupted or sidetracked by comments and questions.	-0.22	0.28	-0.5
Presenters may not be able to act effectively on timing feedback if they are already too far behind or too late in the talk.	-0.39	0.47	-0.9
Presentation timing support should help me to realize when I am in danger of exceeding up upper time limit at any point in the talk.	-0.80	0.75	-1.5

Table 2. Statements that do not strongly distinguish between factors. Lower/higher Z-scores indicate greater dis/agreement with the corresponding statement within the factor, and greater differences indicate greater conflict for the statement between factors.

Three statements in particular differentiated the two factors. Factor A stakeholders did not believe that presentation software should adapt to any changes in the available time or help presenters finish within the time limit. They would also not use any kind of physical timing feedback (e.g., a vibrating phone or wristband) if it had the potential to surprise them. In contrast, Factor B stakeholders wanted presentation software to adapt to changing talk durations and help them finish within the time limit, using physical timing feedback to attract their attention when necessary. These differences arise from complex interaction between the presenter's personality and the presentation situation, and characterize two contrasting *attitudes* to timing support:

- **Less-flexible attitude (Factor A):** the presenter wants to stay in control in a well-rehearsed talk, using a glanceable countdown against coarse, well-tested time targets.
- **More-flexible attitude (Factor B):** the presenter wants to finish on time in a more-improvised talk, following adaptive guidance based on fine, aspirational time targets.

These prototypical attitudes arising from the HCI-Q study can be seen as the extremes of a continuous scale of flexibility in the presenter-timing relationship. Considering these extremes in the design process should encourage the design of timing support mechanisms that satisfy the needs of presenters who lie anywhere in between these extremes.

Implications for mobile application support

The potential for using mobile devices to support both attitudes is high. Both would want to set time targets in advance, with less-flexible presenters testing them more thoroughly in rehearsal. In delivery, less-flexible presenters would prefer to passively glance at a mobile device propped upright on the lectern or positioned as a remote display within sight of the stage. Presenters with a more-flexible attitude may additionally want to use their mobile device in hand, controlling their slides while continuously receiving multimodal visual and haptic feedback designed to actively guide them to a timely talk completion.

Implications for time target setting

The potential for designing a target setting mechanism appropriate for both attitudes is also high. Setting time targets per slide like Time Aura [17] might satisfy presenters with a more-flexible attitude since they would be willing to think about how long they wanted to spend on each slide – the targets are aspirational rather than refined through practice. More-flexible presenters also value continuous feedback (in contrast to that of HaNS [26]). For presenters with a less-flexible attitude, the converse is true. Given their prior refinement and reinforcement of time targets through rehearsals, they would disagree that timing support should help them anticipate when to move to the next slide, which could translate into the feeling of it being an emergency whenever these targets are missed.

To satisfy the broadest range of presenters, a more customizable approach to target setting is required. Several stakeholders suggested the ability to set time targets for variable-length sequences of slides, starting with a time limit for the whole talk and refining into section targets and then slide targets only when necessary. Such division of a talk into different timing zones would provide multiple further advantages for both types of presenters. Greater spacing between targets would make each more salient, providing stronger active guidance to presenters with a more-flexible attitude and reducing chances to make less-flexible presenters feel uncomfortable if they have diverged from their prior timing plan. Fewer targets from a small number of zones may also be more glanceable at a distance in ways that suit less-flexible presenters while giving more-flexible presenters large enough zones to notice and act upon any adaptive adjustments to their time targets.

Goals for the design of presentation timing support

In summary, we present four high-level goals for the design of mobile presentation timing support:

1. Timing should be considered from authoring to delivery.
2. Target setting should be by variable-length slide zones.
3. Visual feedback should be glanceable and forgiving.
4. Physical notifications should be subtle and optional.

DESIGN

We wanted to design a presentation timing companion that would provide an acceptable solution for presenters with different levels of flexibility in their attitude to timing support. In the following sections, we describe how we translated our four design goals into concrete features of a mobile application called TalkZones. This Windows Phone application communicates with a Microsoft PowerPoint Add-In over Bluetooth, synchronizing time data in the XML of the .pptx file format allowing the same presentation to be paired with any mobile device. TalkZones also provides the high-level capabilities of time planning, time feedback, and remote control of the PowerPoint slideshow.

Timing should be considered from authoring to delivery

We set out to explore the potential of mobile devices for presentation timing support, and we concluded that mobile phones are sufficiently flexible to satisfy the needs of both presenter types in a single form factor (e.g., as a handheld remote control and/or a remote timing display, giving passive visual feedback and/or active haptic notifications). Additional screen real-estate on the mobile phone can also help all presenters to set time targets while authoring slides, as well as attempt to follow them in rehearsals that closely anticipate the conditions of the final presentation delivery.

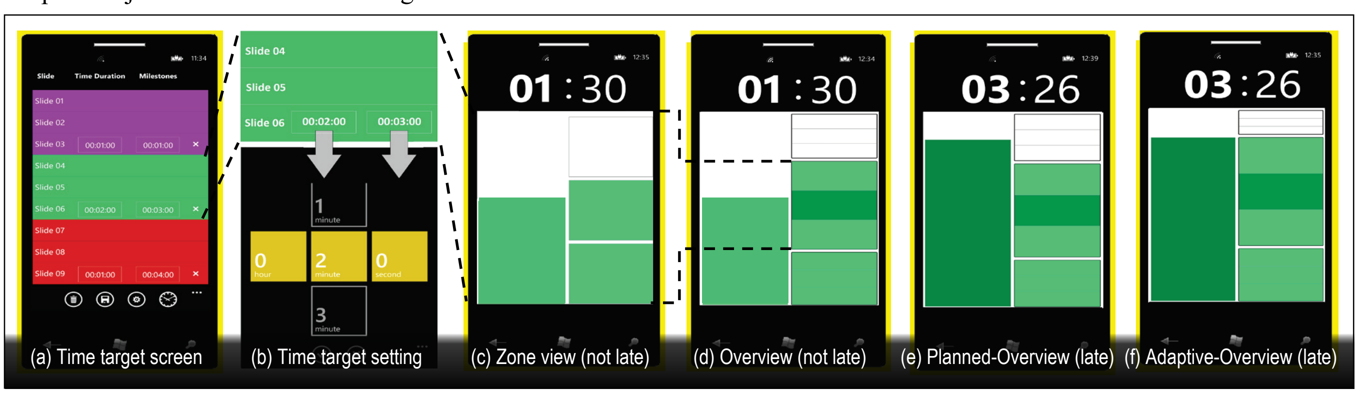

Figure 3. TalkZones presentation timing support. First set time targets by zone (a–b) then select a timing visualization (c, d, e, or f).

(a) Time target screen showing an ordered list of all presentation slides. Tapping on a slide brings up buttons to set the duration or cumulative time milestone for a talk zone ending on that slide. Tapping on a cross removes the corresponding talk zone.

(b) Setting a time target by duration or milestone. Tapping either button opens a time picker that returns to the time target screen.

(c) Zone visualization (not late). 1:30 of the presentation has elapsed and the presenter is on slide 2 of 3 in the current zone. Just over half of the time allocated to the zone has passed. The color follows the color of the zone on the time target screen.

(d) Overview visualization (not late). Showing same timing situation as (c) but in the context of all zones. The darker box indicates the current slide (slide 2 of 3) in the current zone (also zone 2 of 3).

(e) Planned-Overview visualization (late). The time bar becomes darker in color when its height exceeds that of the current zone box, providing redundant visual indications of lateness as measured against the initial timing plan.

(f) Adaptive-Overview visualization (late). Same as (e) with an additional indication of lateness: the ascending time bar, on reaching the top of the current zone box, stretches the current zone box and compresses future zone boxes. Time targets adapt to the delivery.

Target setting should be by variable-length slide zones

We designed a lightweight and flexible approach to time target setting. The user creates time zones as an implicit side effect of assigning a duration or milestone to a slide (Figure 3a-b). Each slide is initially represented as a row in a table that contains columns for the slide index and buttons with which to set the duration or cumulative time milestone of a zone ending on that slide. Tapping either of these takes the user to a time picker control with which they can specify the time period. A zone can be further subdivided by selecting a slide within it or deleted by tapping the cross icon. Usage patterns are free to vary from setting the durations of each slide (like Time Aura [17]) to setting milestones that indicate impending and actual "time up" (like HaNS [26]), as well as supporting the progressive refinement of targets. For example, the user might first set milestones for high-level zones (e.g., 3 sections to finish after 5, 10, and 15 minutes), and then refine these into lower-level slide zones by specifying the durations (e.g., refining the 10-15 minute zone into two zones of 2 and 3 minutes, respectively).

In our target-setting screen, zones are automatically assigned colors in a reverse spectrum from violet to red (Figure 3a). This progression is familiar, uses the widest range of discernable colors, and conveniently represents progress towards the "hot" end of the talk. Using *zone coloring* during delivery (Figure 3c-f), color can provide a glanceable indication of the current zone and the approximate progress through the talk. Iterative rehearsal of a talk and the delivery of multiple talks over time should serve to reinforce this color mapping and accelerate processing of progress made. We also offer *late coloring* – a binary color scheme in which red and blue signify lateness and timeliness according to a blue=cool=on-time and red=hot=late metaphorical mapping. We chose this in preference to a traffic light metaphor since green=speed-up and red=slow-down is contradictory in the context of speaking to presentation slides, and confused users in pilot tests. Red and blue caused no such problems. While *zone coloring* gives feedback about where in the talk the presenter is, *late coloring* provides a simpler indication of how the presenter is doing with respect to time targets.

Visual feedback should be glanceable and forgiving

Our design of a mobile timing companion with flexible target setting supports both less-flexible (Factor A) and more-flexible (Factor B) attitudes through anticipated differences in the number of targets. However, more fundamental differences in visualization preferences could arise from two tensions identified in the HCI-Q study:

- Mental comparison of planned and actual timings (A) vs. Forgiving guidance from adaptive time targets (B)
- Glancing at rough progress against the overall plan (A) vs. Being notified when running late in a zone (B)

We refer to these tensions as *planned vs. adaptive targets* and *overview vs. zone feedback*, creating a 2×2 design space. We filled this design space with a family of timing support visualizations based on the metaphor of a race in which a timing bar on the left, continuously growing upwards, is juxtaposed with boxes stacked on the right representing discrete units of progress. If the presenter moves through their slides at a pace such that the continuous time bar and discrete boxes reach the top of the visualization area together, she will always finish her talk on time.

In our *planned-overview* visualization (Figure 3e), the timing bar represents the passage of time for the whole presentation and the stacked boxes represent presentation zones subdivided into slides (with the current slide highlighted). These zone boxes are shown at a fixed size proportional to their time target planned in advance. In our *adaptive-overview* visualization (Figure 3f), boxes do not remain at an initial fixed size but scale dynamically whenever the presenter is overrunning the zone. These visualizations differ in the quality of forgiveness. *Planned-overview* uses spatial differences between bars to highlight deviations from the prior plan in a way that could be perceived as judgmental or pressurizing. *Adaptive-overview* is more forgiving, stretching the boxes of zones that are being overrun to focus attention on the time remaining (not past lateness).

Our *zone* visualizations (Figure 3c) are full-screen views of the current zone taken from the respective *overview* visualization. The discrete units in this view are the slides of the zone. When moving to a new zone with *adaptive-zone*, the time bar immediately begins filling the screen at a rate determined by the updated target time for that zone. In *planned-zone*, the time bar moves at a pace predetermined by the initial plan and can thus lag behind or already fill part or all of the screen when changing to a new zone. Compared with overviews, zone views have lower resolution, faster visual motion, and larger, full-screen indications of lateness designed to be maximally glanceable.

Physical notifications should be subtle and optional

Presenters with less-flexible and more-flexible attitudes were divided over the use of haptics and its potential to attract/distract the presenter's attention. We therefore focus on visualizations of timing with haptic feedback an optional and redundant representation of lateness. In our system, presenters can choose to receive a one-time vibration of 200ms when they begin overrunning in a zone, as well as each time they physically advances slides within a late-running zone (when speech is momentarily paused and attention to the haptic sensory channel elevated). The initial notification of lateness, while potentially surprising and thus disrupting less-flexible presenters, might be necessary to attract the attention of more-flexible presenters who are overrunning without noticing. Conversely, the notification of lateness on presenter-initiated slide transitions can be anticipated in advance in ways that reduce the potential for surprise, while increasing the continuousness of timing feedback in ways desired by more-flexible presenters.

EVALUATION

Our evaluation of TalkZones spans two related studies. The goals of the first study were to understand how participants choose to configure and use TalkZones under various scenarios, and to compare the performance of TalkZones to that of a regular timer for controlling the pace of a short talk. The second study built on the first by testing how well TalkZones could pace longer talks with speakers' own slides.

Study 1: Presenting Short but Interrupted Talks

We employed a between-subject design because familiarization with materials and timing strategies in one condition could impact performance in the other condition. Half of the participants were asked to use TalkZones after an initial session of training and preference elicitation, while the remaining half of the participants used a minimal TalkZones application configured as a regular countdown timer (showing overruns as negative time in red type).

Participants

We recruited 24 participants (20 male, 4 female) aged 21–32 years (mean 24) from our organization, with backgrounds in science, engineering, and design. All had experience giving timed presentations at international conferences. We divided them into two groups of 12 balanced by self-identified timing attitude from our descriptions (7 less-flexible, 4 more-flexible, 1 neutral in each group). Only the 12 participants in the TalkZones condition participated in the structured elicitation of configuration preferences described below.

Procedure: Collection of TalkZones Preferences

For collecting user preferences, we created a deck of 20 slides each of which contained a prompt the participant could speak to without prior rehearsal. Examples include "My home town" and "My university life". To learn how different numbers of zones might affect visualization preferences, we created three versions of this deck with different targets:

1. Slide targets (20 zones × 1 slide each)
2. Quarter targets (4 zones × 5 slides each)
3. Midpoint target (2 zones × 10 slides each)

To let participants experience the feeling of each combination of these 3 target types and our 4 visualizations, we set the interface to use *zone coloring,* positioned the mobile phone next to the presentation laptop, and gave the participant a handheld clicker to advance slides. We then provided the following instructions for each of the 12 trials combining a target type with a visualization:

1. Speak continuously and maintain good eye contact (as recommended in the presentation literature).
2. Miss early targets by longer times, but gradually catch up (to experience the feeling of recovering from being late).
3. Gradually move back to the longest glanceable distance (to discover the potential of mobile timing display).

For all trials, we preconfigured a talk time limit of 6 minutes 40 seconds. This corresponds to the total time available in the Pecha Kucha [21] talk format of presenting 20 slides, each of which automatically advances after 20 seconds. This format was invented to tackle the problem of presenters overrunning in talks whose allocated time was already longer than needed to communicate the core message. The use of auto-forward is "all important" because "There's no 'next slide' or 'go back one, please' at PechaKucha Nights" [21]. Presenting so many slides in such a short time *without* the use of auto-forward creates a high level of time pressure from the outset, making it an ideal format to test our visualizations.

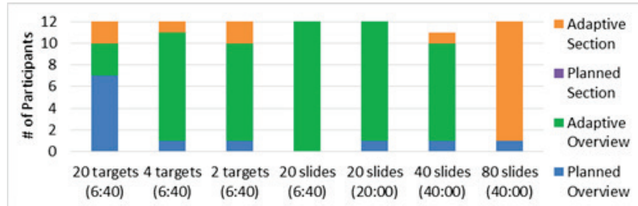

Figure 4. Visualization preferences for different numbers of time targets and talk durations after initial use experiences

Following these sensitizing experiences, we invited participants to experiment with the option of *late coloring* (red for late, blue for not late, regardless of the section) as well as the use of handheld control and haptic feedback. We then collected subjective configuration preferences across a range of typical presentation formats: 20 slide, 6m40s Pecha Kucha style talks and 20-40 minute talks with 20-80 slides.

Procedure: Comparison of TalkZones against Timer

For the final task, participants in both TalkZones and Timer conditions spent 15 minutes rehearsing a premade slide deck of personal talking points to be presented on camera in Pecha Kucha style (with manual slide control). TalkZones users were free to configure the application as they preferred. Control group participants had the same rehearsal time, following an introduction to the task, training in the use of the clicker and timer, and familiarization with the presentation deck. To test the ability of the timing support tool to provide an acceptable recovery strategy, we interrupted each presentation with the same four questions.

Study 1 Results

The first three columns of Figure 4 show how preferences shifted from *planned-overview* to *adaptive-overview* as the numbers of zone targets decreased for a 20 slide, 6m40s talk. With one slide per zone, target adaptation happens on each slide transition in ways participants reported to be disruptive. Participants all preferred *overview* to *zone* because of the feelings of confidence and control that come from easy, glanceable access to complete talk information (the different resolutions of *overview* and *zone* did not affect legibility in the 1-3m viewing range). The shift in choice from *planned* to *adaptive* with decreasing zone targets stemmed from the reduced mental load by not needing to compare actual versus planned-progress (only content versus time remaining), the increased salience of late signals when they occur at a few strategic points in the talk, and the clearer signaling of lateness through dynamic changes to zone size *and* color. *Adaptive* targets should thus be used in non-singleton zones.

The preferred number of zones (with participant frequencies) were 2 (1), 3 (2), 4 (8), and 5 (1), with the majority of participants (9/12) preferring *zone coloring* to *late coloring* because a few memorable zone colors reminded them of the similarly colored timing plan. With too many zones, however, they become less identifiable and hence less useful as a glanceable indication of progress. While preferences for *adaptive* continued with increasing time and slides, 11 participants would prefer to use *zone* feedback for decks of 80+ slides at which point *overview* was found to be illegible. Automatically switching from a default *overview* to a *zone* view once a slide threshold is reached would be reasonable.

In situations where it is appropriate to use a mobile phone to control slides, nine participants would choose to use some combination of the two haptic signals they tested (but none did so during their final talk on account of its formality). Several users suggested adding such feedback to a clicker.

Completion times in the TalkZones condition ranged from a 25s underrun to a 35s overrun, with a mean overrun of 8s (*SD*: 18s), or 2% over the target completion time. In contrast, participants using a regular timer in the control condition all ran over by 25-220s, with a mean of 1m49s (*SD*: 1m11s), or 27% over the time limit. A Welch's t-test revealed a significant difference ($t_{(12.7)}=4.87$, $p<.0001$, Cohen's d=1.97), translating to a 14× improvement with TalkZones.

Overall, participants reported that "it is easy to divide each section [zone]" and that the "smaller goals" of zone targets helped them to "quickly notice the remaining time" when considering slide transitions. When overrunning in a zone, the adaptively "shrinking space" of future zones helped participants to "pre-manage" their timing before it was too late, resulting in a "sense of security" and feeling of control.

Study 2: Presenting Longer but Shortened Talks

Our second study aimed to evaluate whether the effectiveness of TalkZones for pace control of short, intense talks would transfer to longer talks also under time pressure.

Participants & Procedure

We recruited 8 participants (5 male, 3 female) aged 23-38 (mean 27) with backgrounds in science and engineering, with no overlap with participants from earlier studies. Prior to the study, we instructed participants to prepare through prior rehearsal for a 30-minute presentation, using one of their existing presentation decks. Their decks of choice ranged from 37-58 slides, with a mean of 48 slides. On starting the study, we then asked participants to give the actual presentation in just 20 minutes, with the rationale that such enforced, last-minute talk shortening is an unfortunate but common practice in many real-world situations.

Participants used TalkZones preconfigured with the *adaptive-overview* visualization (unanimously preferred by participants in the first study) but could select *zone coloring* or *late coloring*. They were also free to create zones and time allocations as they liked. Talks were video recorded.

Study 2 Results

All participants chose 3-5 zones (mode 4) and the majority (6/8) chose *zone coloring*, consistent with the results of the first study. In their timed talks, the mean and maximum overruns corresponded to 2% (23s) and 10% (2m3s) of the 20 minute time limit, again highly consistent with the 2% and 9% mean and maximum overruns from the first user study.

From these results, we can conclude that TalkZones is an effective means of timing support for short-to-medium length presentations, and that *zone coloring* of fixed but flexible-length talk "quarters" represent a manageable and predictable way to receive and act upon late signals (confirming the expert recommendation in [8]). Taken together, our results suggest that mobile phones are a suitable platform for presentation timing support, and that our TalkZones application gently encourages presenters to advance slides before it is too late to recover, even under the adverse timing conditions of short and shortened talks.

CONCLUSION

We have presented TalkZones – a mobile application and presentation timing companion that supports the setting and following of time targets using variable-length slide zones. Across two user studies, TalkZones consistently controlled presentation pacing in ways that minimized talk overruns, demonstrating its effectiveness even under the adverse timing conditions of short and shortened presentations.

This work makes progress in a problem space well investigated in the literature but not previously addressed by systems validated in empirical studies. In an attempt to understand how to improve upon prior systems, our HCI-Q study revealed two contrasting attitudes towards presentation timing, as well as the potential advantages of mobile application support and the need for a more flexible, zonal approach to working with time targets. Our design process aimed to support both timing attitudes through a family of related visualizations. However, we found that one visualization in particular, which adapts timing targets within the context of an overview of all talk zones, was preferred by all participants for almost all presentation scenarios. For more formal talks like the ones forming the basis of our studies, all participants also preferred to use TalkZones as a remote timing display. In the case of less formal, more improvisational talks, TalkZones can also offer handheld slide control augmented with haptic timing feedback. Overall, we can recommend a single paradigm for timing support in a mobile phone application that embodies convenience, effectiveness, and flexibility in use.

Future work should investigate the design of handheld clickers or wearable devices for multimodal presentation pacing that is not primarily visual. Another area to explore is how to support the timing of non-linear presentations. For example, zoomable presentation systems like Prezi [24] and Fly [16] have a preset path but also support seamless and impromptu navigation away from this path. For such systems, our concept of talk zones could be mapped to spatial areas of the canvas rather than to sequences of slides. Our existing adaptive time guidance could be modified to support such non-linear navigation by treating revisitation as the norm rather than the exception. Exiting a zone early would allow the zone to retain its unused time allocation, while remaining in a zone beyond its time allocation would consume remaining time from all zones with a time surplus (not just unvisited ones). Similarly, for hierarchical presentations such as with HyperSlides [10], time targets could be specified for each of the high-level "scene" slides, with the time allocation cascading down to subordinate "detail" slides. In each case, future work should explore how non-linear visualizations can communicate the spatial or hierarchical distribution of time targets.

Assessing the suitability of the TalkZones visualizations for other display surfaces and activities, such as use on meeting room walls for ambient time management [18], would generalize and extend the current contribution. Finally, within the activity of presenting, larger-scale studies in naturalistic contexts such as academic and business conferences would go even further towards demonstrating the value of TalkZones for presenters and audience alike.

REFERENCES

1. Abela, A. (2008). Advanced Presentations by Design: Creating Communication that Drives Action. Pfeiffer.
2. Ayres, J. (1996). Speech preparation processes and speech apprehension. Communication Education, 45, 228-235.
3. Atkinson, C. (2005). Beyond bullet points: Using Microsoft PowerPoint to create presentations that inform, motivate, and inspire. Microsoft Press.
4. Bailey, B.P., Konstan, J.A., & Carlis, J.V. (2001). The effects of interruptions on task performance, annoyance, and anxiety in the user interface. INTERACT'01, 593-601.
5. Brown, S.R. (1980). Political subjectivity: Applications of Q Methodology in political science. Yale University Press.
6. Buehler, R., Griffin, D., & Ross, M. (1994). Exploring the "planning fallacy": Why people underestimate their task completion times. Journal of personality and social psychology, 67(3), 366-381.
7. Dempsey, D.J. (2010). Present Your Way to the Top. McGraw Hill.
8. Duarte, N. (2012). Harvard Business Review Guide to Persuasive Presentations. Harvard Business Review Press.
9. Dunne, A. & Raby, F. (2001). Design noir: The secret life of electronic objects. August Media.
10. Edge, D. Savage, J. & Yatani, K. (2013). HyperSlides: dynamic presentation prototyping. CHI'13, 671-680.
11. Eisler, H. (1976). Experiments on subjective duration 1868-1975: A collection of power function exponents. Psychological Bulletin, 83(6), 1154-1171.
12. FlashQ. http://www.hackert.biz/flashq/home/
13. Gillie, T., & Broadbent, D. (1989). What makes interruptions disruptive? A study of length, similarity, and complexity. Psychological Research, 50(4), 243-250.
14. Kahneman, D., & Tversky, A. (1977). Intuitive prediction: Biases and corrective procedures. TIMS Studies in Management Science, 12, 313-327.
15. Kreifeldt, J.G., & McCarthy, M.E. (1981). Interruption as a test of the user-computer interface. Annual Meeting of the Human Factors and Ergonomics Society, 87-91.
16. Lichtschlag, L., Hess, T., Karrer, T. & Borchers, J. (2012). Fly: studying recall, macrostructure understanding, and user experience of canvas presentations. CHI'12, 1307-1310.
17. Mamykina, L., Mynatt, E. & Terry, M.A. (2001). Time Aura: Interfaces for Pacing. CHI'01, 144–151.
18. Occhialini, V., van Essen, H. & Eggen, B. (2011). Design and Evaluation of an Ambient Display to Support Time Management during Meetings. INTERACT'11, 263-280.
19. Office Remote. http://research.microsoft.com/en-us/projects/officeremote/
20. O'Leary, K., Wobbrock, J.O. & Riskin, E.A. (2013). Q-Methodology as a Research and Design Tool for HCI. CHI'13, 1941–1950.
21. Pecha Kucha 20x20. http://www.pechakucha.org/faq
22. Pousman, Z. & Stasko, J. (2006). A taxonomy of ambient information systems: 4 patterns of design. AVI'06, 67-74.
23. PQMethod. http://www.lrz.de/~schmolck/qmethod/
24. Prezi. http://prezi.com
25. Spicer, R., Lin, Y. R., Kelliher, A., Sundaram, H. (2012). NextSlidePlease: Authoring and delivering agile multimedia presentations. TOMCCAP, 8(4).
26. Tam, D., MacLean, K.E., McGrenere, J. & Kuchenbecker, K.J. (2013). The Design and Field Observation of a Haptic Notification System for Timing Awareness during Oral Presentations. CHI'13, 1689-1698.
27. Treisman, L. (1985). Preattentive processing in vision. Comp. Vision, Graphics, and Image Proc., 31(2), 156-177.
28. Trinh, H., Yatani, K. & Edge, D. (2014). PitchPerfect: Integrated Rehearsal Environment for Structured Presentation Preparation. CHI'14.
29. Warnock, D., McGee-Lennon, M.R., & Brewster, S. (2011). The impact of unwanted multimodal notifications. ICMI'11, 177-184.
30. Wisneski, C., Ishii, H., Dahley, A., Gorbet, N., Brave, S., Ullmer, B. & Yarin, P. (1998). Ambient Displays: Turning architectural space into an interface between people and digital information. CoBuild, Springer LNCS, 1370.
31. Zakay, D., & Block, R. A. (1997). Temporal cognition. Current Directions in Psychological Science. 6, 12-16.