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Assisted entry mitigates text messaging-based driving detriment

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Abstract. Previous research using cell phones indicates that manual manipulation is not a principal component of text messaging relating driving detriment. This paper suggests that manipulation of a phone in conjunction with the cognitive need to compose the message itself co-act to contribute to driving degradation. This being so, drivers sending text messages might experience reduced interference to the driving task if the text messaging itself were assisted through the predictive T9 system. We evaluated undergraduate drivers in a simulator who drove and texted using either Assisted Text entry, via Nokia's T9 system, or unassisted entry via the multitap interface. Results supported the superiority of the T9 system over the multitap system implying that specific assistive technologies can modulate the degradation of capacity which texting tragically induces.

Keywords: Driving, Text Messaging, SMS, Driver Distraction

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1. Introduction

Diverse studies have demonstrated driving degradation due to text messaging. Such performance diminution involves changes in headway, speed variability, lane position, lane change behavior and following distance (Crisler, et al, 2008; Hosking, Young, & Regan, 2009; Tijerina et al, 1995). However, current understanding aligns with the notion that the presence of a phone in an individual's hand and the act of pressing keys is not the prime source of these respective effects (Sawyer & Clegg, 2010). Much the same is true in vocal cell phone use, the presence of the phone in hand of an individual introduces a relatively minimal level of load when compared to the substantial contributions of factors like the cognitive load of language, its conception and delivery (Strayer & Johnston, 2003). Indeed, Sawyer and Clegg's (2010) evidence suggest that in text messaging the source of the load could likewise be the cognitive facets of language processing.

In text messaging, language is not mediated by the naturalistic medium of speech. Rather, a cell phone user must internally compose a message, then access an interface within the phone and convert that message into text. Therefore, although the presence of the phone in the hand of the individual may not constitute any significant source of cognitive load, nonetheless, the interface that allows that individual to convey to the phone software the composed message seems a likely candidate to contribute load to the driving process. Given that the manual text transcription process includes visual and tactile perception, processing and action tasks, tapping the very pools of cognitive resources that driving draws from (see Wickens, 1984), it seems likely that this component of text messaging drives up mental workload significantly. Although this may have no immediate effect upon the driving task, this increase in workload effectively limits the stable load level possible (Hancock & Warm, 1989). A spike in overall driver workload, unexpected or not, is therefore more likely to lead to dynamic instability and a failure, and possibly a catastrophic one, in the driving task. Although the existing research suggests a minimal role for manual manipulation driven detriment in text messaging, it is suggested that existing inquiries have looked at manual manipulation in isolation, without adding in this language driven component of composition.

In the current study we have restricted our discussion of text input to single-handed entry on a physical keypad. Many keypads for text messaging exist, but the most popular remains the nine key. Nine key phones use one of two systems for text entry: Multi-tap, in which the button is pressed to cycle through letters, or a predictive system such as Nuance Communications' T9, requiring only one tap per a letter. T9 can be considered an assistive technology that, according to Nuance, "…aids in and speeds message composition." (Nokia, 2007) Indeed, if typing the word "welcome" on a multi-tap system the user must press 15 keys, while on a T9 system they need press only 7. Given what Miller (1956) and subsequently Baddeley (1975) have suggested about short term memory, that at least in terms of numerals it holds seven plus or minus two, it seems likely that this distinction between multitap and T9 might be important. Further, T9 often allows the user to skip the transliteration that multitap entails, in which the user must code each letter not only to a physical location but to a number of taps.

If manual manipulation in conjunction with cognitive composition of language contributes to driving degradation, drivers sending text messages might enjoy reduced costs to the driving task if the text messaging task were assisted through the predictive T9 system. It was therefore hypothesized that participants using the predictive T9 technology would exhibit fewer costs to driving while texting.

2. Methods

This paper describes an early exploratory effort to ascertain whether automation might mitigate the detriment of text messaging in driving. Data from a previous driving study was re-analyzed. Twenty-nine

Figure 1: The Nokia 8801 Cell Phone. For the study, the slider was non-destructively blocked to prevent accidental closure.

participants in the initial study were tested on a single phone, a Nokia 8801(Fig. 1). Each participant was asked for a preference which system they had the most previous experience on: 5 chose multitap and 24 chose T9. They were then given a series of training sessions on the phone using their preferred scheme, and their texting speed was tested to a criterion of 35 Characters per minute. A variant of the pace car cell phone study methodology (Fig. 1) utilized in many studies of vocal cell phone use while driving (Strayer, 2003) was adapted for the current study. Participants were placed on the roadway and asked to follow the car in front of them, which braked suddenly at unexpected intervals. Four measures of driving quality were recorded. Brake onset was defined as the interval in seconds between illumination of the pace car's tail lights and onset of the participant's depression of the simulator brake pedal. Brake offset was defined as the interval in seconds between brake onset and the time that the simulator brake pedal was completely released. Following distance was defined as the mean distance in meters between the participant's car and the pace car over the duration of the drive. Finally, total numbers of accidents were also recorded, and were then divided by hours driven to produce an accidents/hour of driving time measure. Participants in the original study drove in a number of conditions, but in the current re-analysis only considered the conditions in which the participant was actively texting and the baseline in which they drove with the phone in the vehicle on the passenger side seat. These baseline and texting conditions were fully counterbalanced. Four equivalent scenarios were generated and were counterbalanced between conditions. The virtual environment in which they drove was composed hilly terrain, curves, and constant oncoming traffic.

3. Results

Four 2x2 (Baseline, Texting x T9, Multitap) ANOVAs were run on the DVs of Brake Onset, Brake Offset, Following Distance and Accidents, followed by post-hoc Tukey's HSD. Drivers using T9 while texting had significantly faster brake onset (Fig. 2) than drivers using multitap, while, as expected, their baseline reaction time showed no significant differences. No significant differences were seen in brake offset times between T9 and multitap text messengers. However, there was a significant difference in the number of accidents (Fig. 3) for text messaging subjects, such that those using T9 experienced significantly fewer accidents. Finally, following distance (Fig. 4) for text messaging drivers using multitap was significantly greater.

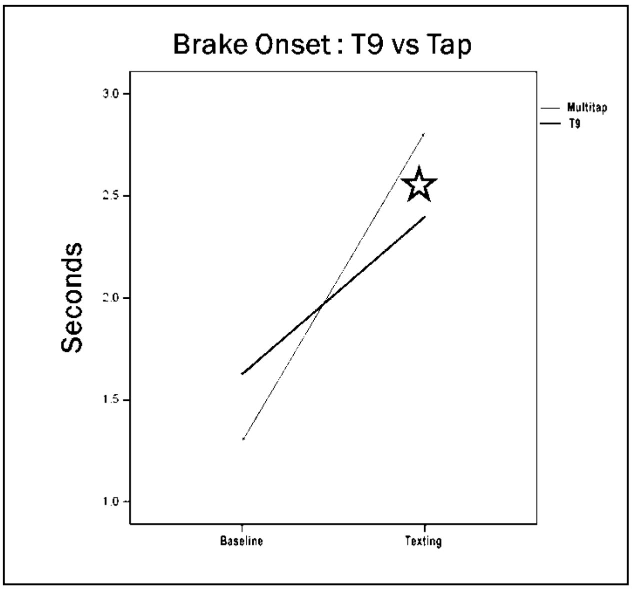

Figure 2: 2x2 ANOVA (Baseline, Texting x T9, Multitap) for Brake Onset data. Star denotes significance.

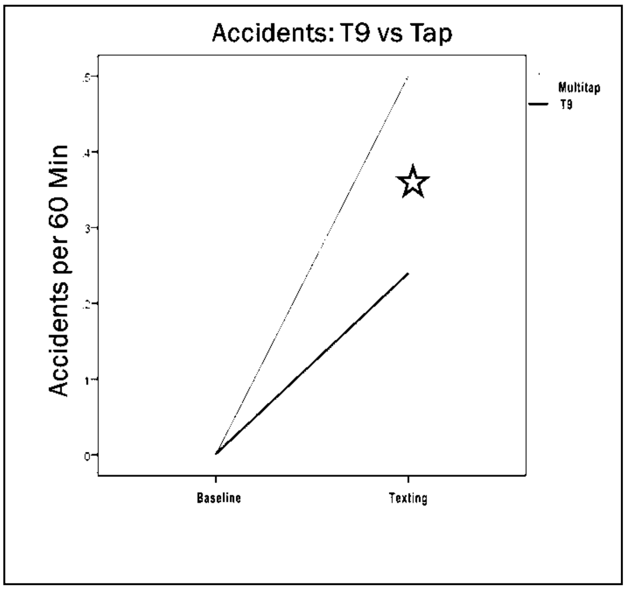

Figure 3: 2x2 ANOVA (Baseline, Texting x T9, Multitap) for Brake Onset data. Star denotes significance.

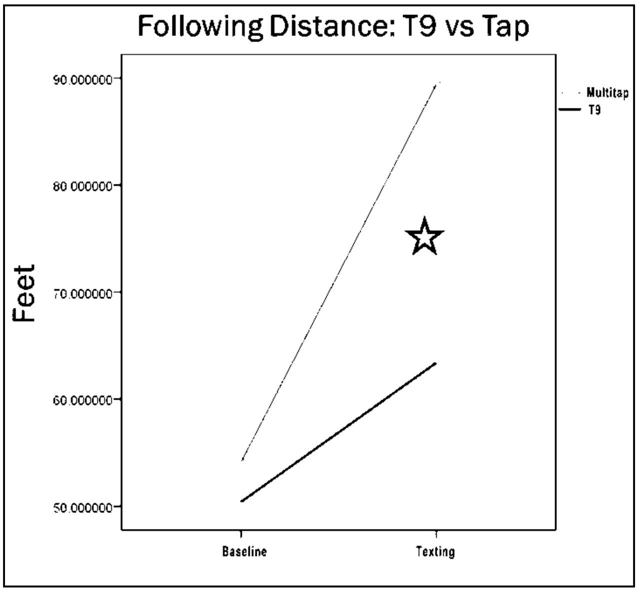

Figure 4: 2x2 ANOVA (Baseline, Texting x T9, Multitap) for Accident data. Star denotes significance.

5. Discussion

These data suggest that interaction between manual manipulation and language preparation and delivery contributes to driver detriment during text messaging. These data also suggest that assistive technologies can mitigate that detriment, at least to a degree. However, this conclusion was reached based on a post-hoc reanalysis of the data, in which the current power was insufficient and assignment of groups was self-directed rather than randomized. Although the results are thus interesting from the point of view that they signpost direction for further research, a replication is considered necessary before drawing any definitive conclusions. That being said, the implications of confirmation of the present outcome with the identified methodological weaknesses addressed, are certainly promising. Building less distracting text messaging for in-vehicle use is arguably a highly competitive strategy for mitigating the toll text messaging exacts in lives, as it would allow a broad mitigation of the underlying cognitive issues that drive the problem. However, we realize that this is a palliative strategy, as compared to preferred options that ban such dual-task performance during the critical act of driving. However, advancements in this arena could be generalized to text entry in other high pressure and high workload situations that do not necessarily demands the constant application of attention by the operator. At the very least, these findings add an important puzzle piece to a growing picture of the complex interactions of tasks and associated load that underlie text messaging while driving and texting in other performance arenas.

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