Chapter 24
Smartwatches vs. Smartphones: Notification Engagement While Driving

Wayne C.W. Giang
University of Toronto, Canada

Huei-Yen Winnie Chen
University of Toronto, Canada

Birsen Donmez
University of Toronto, Canada

ABSTRACT

This work seeks to understand whether the unique features of a smartwatch, compared to a smartphone, mitigate or exacerbate driver distraction due to notifications, and to provide insights about drivers' perceptions of the risks associated with using smartwatches while driving. As smartwatches are gaining popularity among consumers, there is a need to understand how smartwatch use may influence driving performance. Previous driving research has examined voice calling on smartwatches, but not interactions with notifications, a key marketed feature. Engaging with notifications (e.g., reading and texting) on a handheld device is a known distraction associated with increased crash risks. Two driving simulator studies compared smartwatch to smartphone notifications. Experiment I asked participants to read aloud brief text notifications and Experiment II had participants manually select a response to arithmetic questions presented as notifications. Both experiments investigated the resulting glances to and physical interactions with the devices, as well as self-reported risk perception. Experiment II also investigated driving performance and self-reported knowledge/expectation about legislation surrounding the use of smart devices while driving. Experiment I found that participants were faster to visually engage with the notification on the smartwatch than the smartphone, took longer to finish reading aloud the notifications, and exhibited more glances longer than 1.6 s. Experiment II found that participants took longer to reply to notifications and had longer overall glance durations on the smartwatch than the smartphone, along with longer brake reaction times to lead vehicle braking events. Compared to the no device baseline, both devices increased lane position variability and resulted in higher self-reported perceived risk. Experiment II participants also considered that smartwatch use while driving deserves penalties equal to or less than smartphone use. The findings suggest that smartwatches may have road safety consequences. Given the common view among participants to associate smartwatch use with equal or less traffic penalties than smartphone use, there may be a disconnect between drivers' actual performance and their perceptions about smartwatch use while driving.

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1. INTRODUCTION

Smartphones, one of the most popular consumer electronic devices today, go beyond traditional phone functions such as texting and calling, and provide continuous access to social media, current news, and many other information sources. The extensive amount of time that many spend on their smartphones has led to habits and even addictions formed towards smartphone use (e.g., Bayer & Campbell, 2012; Oulasvirta, Rattenbury, Ma, & Raita, 2012; Walsh, White, & Young, 2010); in one study, participants were found to check their smartphones on average 34 times a day (Oulasvirta et al., 2012). Such dependency on smartphones is problematic when these devices are brought into the vehicle. At any given time, an estimated 1.7% of U.S. drivers are manipulating their handheld devices on the road (Pickrell, 2015), and naturalistic driving studies reveal that visual-manual interactions with these devices in particular lead to a major increase in crash risks (Fitch et al., 2013; Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006).

New forms of smart, connected devices that are finding their ways into the vehicle can also create use patterns that may lead to safety decrements. A notable trend over the past few years is the marketing of wearable technologies such as smartwatches and Google Glass as consumer products. As devices that are worn or attached to the body, wearables are highly portable and often make use of multiple input modalities (e.g., touch, voice, or gesture), thus making their functions even more accessible to drivers on the road. Smartwatches, in particular, are rapidly gaining popularity among consumers: 19 million units are estimated to ship in 2015 and 103 million units in 2019 (Danova, 2015). Worn on the user's wrist like a traditional watch, smartwatches are connected to the user's smartphone via Bluetooth for accessing notifications about incoming emails, text messages, etc. Some smartwatches also provide additional functions such as initiating or taking calls. Given the expanding smartwatch user base and the variety of functions smartwatches provide, there is a need for understanding how drivers interact with smartwatches and what potential consequences smartwatches may have on road safety.

To the best of our knowledge, in addition to the two experiments we report in this paper, only one other study so far has examined smartwatch use while driving. Samost et al. (2015) used a simulated car following task, combined with a remote detection response task, to compare smartwatch and smartphone use for initiating phone calls. No driving performance differences were found for voice calling (auditory-visual), a somewhat expected result given that the voice input methods on the two devices were similar. Compared to voice calling on either device, visual-manual calling on the smartphone led to worse driving performance in terms of lane deviation and major steering wheel reversals. While Samost et al. (2015) focused on the voice calling aspect of a smartwatch, the most popular function of smartwatches is the notification system. Positioned on their wrist, smartwatches allow users to filter their incoming notifications without having to reach for their smartphone (Marks, 2013).

Whether from a smartphone or a smartwatch, notifications carry the risk of diverting attention away from the main driving task. Distraction due to notifications may have two components. On one hand, drivers may intentionally engage with notifications (e.g., texting a response to an incoming message), a visual-manual task that is known to increase crash risk considerably when performed on a handheld phone (Fitch et al., 2013). On the other hand, with or without intending to engage with notifications, drivers may be involuntarily affected by the auditory, visual, and/or tactile alerts that accompany notifications (Marulanda, Chen, & Donmez, 2015; Regan, Hallett, & Gordon, 2011). The sudden onset of peripheral visual stimuli (without message content), for example, has been shown to attract visual attention and