Cell Phone Conversation and Relative Crash Risk

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INTRODUCTION

Scope

This article is limited to studies that estimate the relative crash risk of conversation on a cell phone during real-world, non-experimental driving in passenger vehicles.

The scope does not include:

- *Heavy vehicles* such as tractor-trailers or tankers;
- *Visual-manual cell phone tasks* (e.g., searching for a phone, 10-digit manual dialing, manual texting), and
- *Experimental studies* of cell phone conversation.

Experimental studies are not included because they cannot make valid estimates of actual crash risk, which requires real-world driving data. Experimental studies are conducted in a driving simulator, on a road or track closed to other traffic, and on public roadways, while the driver is under experimental control. The experimenter usually manipulates the timing and demands of secondary tasks, in artificial scenarios not freely chosen by the driver. In addition, experimental studies rarely represent driving conditions, demand levels, and environmental conditions that drivers will actually experience during real-world driving. In contrast, during real-world driving, drivers can choose whether, where, when, and how to engage in a secondary task during the primary driving task.

Definitions of Terms

A few brief definitions of basic terms will facilitate understanding of the research reviewed in this article.

- **Driving Terms:** *Driving* is defined herein by the primary tasks of steering, pressing the accelerator, braking, and detecting and responding appropriately to objects and events in the roadway. (In the minority of vehicles with manual transmissions, these primary tasks would also include pressing and releasing the clutch pedal and operating the gearshift lever.) These tasks are at the immediate control level of vehicle operation, and occur in short time intervals (milliseconds or at most a few seconds). They are observable and measurable driving behaviors, which are those commonly evaluated in assessments of the effects of distraction on driver performance. The definition of driving given by Michon (1985) labels these tasks as short-term, low-level *operational* control tasks. The term *primary driving* is used herein to refer to these operational tasks. Michon (1985) also describes medium-term, mid-level *tactical* driving tasks such as maneuver control that allow drivers to negotiate the current environmental circumstances (e.g., avoid obstacles, accept traffic gaps, turn, decide when and whether to pass a vehicle, select and maintain an appropriate speed, check

mirrors, decide when to exit a freeway, etc.). Michon (1985) also describes longer-term, high-level *strategic* driving tasks such as route planning (selecting destinations and waypoints and the best routes to take), deciding when to begin a trip, etc. *Real-world driving* means driving a vehicle in an everyday manner, without experimental instructions. In real-world driving, tasks such as cell phone conversation that are secondary to the primary driving tasks, if performed at all, are performed at times and under traffic and environmental conditions chosen by the driver, not an experimenter. *Naturalistic driving* is a subset of real-world driving, wherein the driver's vehicle is equipped with video cameras that record the driver's behavior. Other instruments also record the vehicle's behavior, in real time while a vehicle is driven in everyday fashion over a prolonged period, from months to several years.

- **Crash and Risk Terms:** *Crash* is defined as any contact by a moving vehicle with another moving or fixed object. Crash *severity* ranges from minor (e.g., a curb strike with a tire), to property-damage, to injury, to fatal. *Crash risk* is the probability of crash occurrence. *Relative crash risk* is the crash risk when engaged in a secondary task such as a cell phone conversation while driving, divided by the crash risk when not engaged in that task while driving. *Relative risk* is used here as a generic term to refer to the risk ratio, the rate ratio, or the odds ratio, all of which are technical terms to estimate relative risk in different epidemiological study designs. All of these estimates approximate each other for rare events (Rothman et al., 2008; Rothman, 2012). *RR* is used here as an acronym for relative crash risk. RR is the crash risk when engaged in a secondary task while driving divided by the crash risk when

not engaged in that task while driving. A task RR above 1.0 means the risk is greater when engaged than when not engaged. A task RR near 1.0 means that the risk when engaged is approximately the same as when not engaged. A task RR below 1.0 means the risk is smaller when engaged than when not engaged (i.e., a *protective* effect indicating a potential safety benefit). The acronym *CI* in this article stands for "95% Confidence Interval." If the underlying statistical model is correct and there is no bias, a CI derived from a valid analysis will, over unlimited repetitions of the study, contain the true RR with a frequency no less than 95% of the time (Porta, 2008, p. 49). Many confounding factors (e.g., traffic and environmental conditions, driver demographic characteristics) can bias RR estimates either up or down from the true RR, and an analyst must control for these confounding factors to estimate a valid RR. The *case window* is the period just before the estimated time of the crash. The *control window* is the period with the same clock-time as the case window, but on some specified day before the crash.

- **Cell Phone Terms:** *Cell phone conversation* is defined in this article as talking or listening on a wireless cellular device. The shorthand term *Talk* is used throughout this article as a synonym for "cell phone conversation." *Wireless cellular device* includes hand-held phones, hands-free portable phones, and hands-free embedded devices. *Embedded* means a wireless device integrated into the vehicle by the vehicle manufacturer, such as the OnStar device. An embedded device is not generally referred to as a "phone," in order to distinguish it from a portable or "nomadic" phone that people carry into the vehicle, and which can be used outside the vehicle as well. "Talk" is an example of a

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