CHAPTER I

INTRODUCTION

The rapid and continuing growth of cellular phone use and its invasion into the automobile has raised concern for potential effect of this wireless equipment on collision risk. There were approximately 58 million cell phone users in Thailand in 2005 (1). Recent survey indicated that 85% of cell phone owners use their phone while driving, and 27% use their phone on half of the trip (2). Although, the precise effects of cell phone use on public safety are unknown, driver inattention has been linked to as much as 50% of motor-vehicle accidents on the U.S highways (3). Motor vehicle collisions are the leading cause of death in Thailand. It was reported that there were 122,040 accidents in 2005 and 1,495 million baht lost by these accidents (4). The major cause of these accidents was drunk driver (5). Although, the contribution of cell phone use while driving to motor vehicle collision is not well identified, this issue is of public interest.

Results from previous studies regarding to the effects of cell phone use while driving were inconclusive. Some studies found negative impact of cell phone use on driving performance (6-8) while others found no effect of cell phone use on driving performance (9). Results from epidemiological studies suggested that drivers who regularly use mobile phone in their vehicle, including hand free phone, have an increasing risk of having accident compared to drivers who do not use a mobile phone (10). Several driving simulation studies indicated that cell phone use degrades various aspects of driving performance such as breaking reaction time (11), (8) and steering wheel control (12). In contrast, Liu (9) found that driving performance did not

degrade when the driver drove in a low driving load environment and when the telephone communications were short. In addition, Goodman et al. (13) found that simple phone conversation did not adversely affect the ability to maintain road position. The differences in findings among previous studies may be due to several factors such as the demanding of the driving task, types of cell phone use (hand held or hand free), types of phone conversation (simple or complex), and the duration of the driving and conversation. Thus, it seems inappropriate to make a general conclusion about the effects of cell phone use on driving performance. Future studies need to investigate the effects of each factor associated with cell phone use on driving performance.

Previous study suggested that the interference associated with cell phone use is due to cognitive factors such as conversation content rather than to peripheral factors such as manipulating the phone (14). In addition, the time taken to manipulate the phone is relatively short when compared to the time that most drivers talk on the phone. Therefore, the present study aimed to investigate the effects of conversation types on driving performance.

Dual-task operation such as simultaneously driving and talking on the phone may cause cognitive overload which consequently resulted in increased attention deficit. Cognitive workload had been measured in previous studies using a questionnaire (15). The limitations of using a questionnaire included its subjectivity, insensitivity, and it had to be done after the task was completed. Physiological parameters such as heart rate, heart rate variability (HRV), and skin temperature have been widely used in behavioral studies to indicate the changes of cognitive workload (16, 17). However,

according to our knowledge, these parameters have never been used in driving simulation study.

The purposes of the present study were to investigate the effects of cell phone conversation types on driving performance and cognitive workload. There were three types of phone conversation; no phone conversation (NC), simple phone conversation (SC) and working memory phone conversation (WC). Brake reaction time, lane maintenance and crash avoidance ability were used as indicators for driving performance. Heart rate, HRV, and skin temperature were used as indicators for cognitive workload.

Research questions and Hypothesis

Research questions

1. Do phone conversations affect driving performance and cognitive workload?

2. Do phone conversation types affect driving performance and cognitive workload?

Hypotheses

1. Driving performance

Driving performance will be poorest in the WC condition, followed by the SC and NC condition, respectively.

Poor driving performance will be characterized by:

- Delayed brake reaction time
- Increased in the numbers of lane crosses and object crashes

2. Cognitive workload (measured through physiological changes)

Cognitive workload will be highest in the WC condition, followed by the SC and NC condition, respectively.

Increase of cognitive workload will be characterized by:

- Elevated heart rate
- Elevated skin temperature

HRV will indicate greatest sympathetic activity in the WC condition, followed by the SC and NC condition, respectively. Moreover, autonomic imbalance will be presented in the WC and SC conditions.

Increase of sympathetic activity and autonomic imbalance will be characterized by:

- Increase of LF and LF/HF ratio
- Decrease of RMSSD and HF

Purposes

General objective

The purposes of this study were to investigate the effects of cell phone conversation types on driving performance and cognitive workload (physiological characteristics).

Specific objectives

1. To compare driving performances (i.e. brake reaction time, the number of lane crosses and object hits) while performing a driving task through a computer simulation in three conditions

- No phone conversation condition (NC)
- Simple phone conversation condition (SC)
- Working memory conversation condition (WC)

2. To compare participant's physiological changes (i.e. heart rate, skin temperature, RMSSD, LF, HF and LF/HF ratio) while performing a driving task through a computer simulation in the above three phone conversation conditions.

Application advantages

The results from the present study will reveal the effects of cell phone conversation types on driving safety. This information may be helpful for public awareness and government policy for road safety.