Effects of Audio Cues for a Song Searching Task on Cell Phone While Driving

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ABSTRACT
Driving distraction is a vital issue within driving research. This paper discusses ongoing research in applying auditory cues to enhance song-searching abilities on a portable music player or smartphone while driving. Previous research related to this area has revealed issues with using these devices while driving but some research has shown significant benefits in using audio cues.

Categories and Subject Descriptors
H.5.2 [**Information Interfaces And Presentation (e.g., HCI)**]: User Interfaces – Auditory (non-speech) feedback, graphical user interfaces (GUI), interaction styles (e.g., commands, menus, forms, direct manipulation), user-centered design, voice I/O

H.5.1 [**Information Interfaces And Presentation (e.g., HCI)**]: Multimedia Information Systems – audio input/output

General Terms
Design, Experimentation, Human Factors, Performance.

Keywords
Audio cues; Driving; Lane change task; In-vehicle technologies

1. INTRODUCTION
Driver distraction is a critical issue within the modern driving world, with large amounts of research (and press) reporting decreases in driving performance when drivers take part in other (distracting) tasks. Some of the more prevalent studies investigate the detrimental impact of activities such as texting [1] or talking on a cell phone [2]. However, relative to time in the car, these are not necessarily the most often performed actions that can cause distraction. One topic that is often ignored is that of driving and list selection, such as finding a song on a phone or mp3 device.

2. DRIVING AND MP3
Smartphones and mp3 players' prevalence has increased in the past years and accordingly their use and popularity within the vehicle has increased as well. However, compared to in-vehicle radio systems, smartphones and mp3 players were not designed with driving as a primary task in mind. Some recent research has investigated the use of these handheld devices for song selection while driving [3][4]. A simulator study showed a significant decrease in visual attention on the driving task as well as decreases in driving performance [3]. While these studies have investigated the results of driving while finding songs, little research has been done investigating how to remedy this issue.

3. ADDING AUDITORY CUES
Auditory cues have been shown to be useful in a menu search task, specifically cues such as spindex and spearcons (for a full explanation on these cues see [5]). These sorts of cues could be applied to the mp3 search task in an effort to decrease visual demands on the driver, thereby reducing the negative impact on driving. According to multiple resource theory [6] by giving the cues through audition, visual demand would not be as tasked, therefore leaving more visual resources to be applied towards the primary driving task. Our own previous research applying these cues within the driving context has shown promising results in multiple settings, including finding songs on a in-vehicle infotainment system (a "head unit") [7], and a driving task in a mid-fidelity simulator [8].

4. PRESENT STUDY
The present work in progress is investigating the cognitive, performance, and visual effects on driving while performing a secondary menu search task on a smartphone, with or without auditory cues.

4.1 Method

4.1.1 Participants
The sample of participants will be composed of undergrad psychology majors. They will receive extra credit in one of their courses for participating in the study.

4.1.2 Apparatus
The primary task of driving will be the Daimler Chrysler Lane Change Task (LCT) and will help to measure distraction and driving performance. The task will be performed using a Logitech steering wheel and pedal, and displayed on an LG TV and audio presented through Dell A215 desktop speakers. The secondary task of the search task will be performed on a Google Nexus One HTC1 Android smartphone running version 2.3.6. The application used for this song-finding task will be similar to the "flicking" block of trials in [4], including the same list of 150 songs. This flicking technique was chosen since the majority of smartphones and mp3 devices currently employ this method of interaction. A

Figure 1. An individual performing the primary driving task and secondary task of navigation a list of songs.

few modifications were made on the application however, including auditory presentation of the search request and a four second break between each request. These auditory stimuli and the cues used during the searching will be presented on Dell A215 desktop speakers. Participants will also wear Tobii eye-tracking glasses (see Figure 1), to investigate visual attention. Questionnaires used in the study will include the NASA Task Load Index (TLX) to measure cognitive load, Edinburgh Handedness Test, a preference questionnaire to compare which auditory cues were preferred, and a demographics questionnaire.

4.1.3 Procedure

Participants will complete consent forms, and receive a short description of the tasks. Participants will complete the Edinburgh Handedness Test, followed by fitting and calibration of the Tobii eye-trackers. They will then perform a short practice drive on the LCT to allow them to become familiar with the task.

Participants will then begin the testing blocks, during which they will hold the cell phone in their choice of one hands, with arm resting on the armrest of the chair throughout the study. They will interact with the phone during the testing blocks with just one hand while the other will be on the steering wheel. During any block where interaction with the phone is not needed, participants will still have the cell phone in their hand. The six testing blocks will be randomized across participants and will include: Search task no sound, search task with text to speech (TTS), search task with spindex and TTS, search task with spearcon and TTS, search task with spindex spearcon and TTS, and no search task. Each of the testing blocks consists of the introduction to the current type of auditory cue followed by a short practice with that version of the cue. They will then drive one length of the LCT, which consists of 18 signs and lane changes. Each participant will complete every possible lane change (i.e. left to center, right to left, etc.) with order randomized. Immediately after each drive participants will perform the NASA TLX followed by a rating form regarding those auditory cues. After completing the six conditions participants will be asked to fill out the short demographics survey followed by a debriefing.

The driving data will be analyzed using the LCT analysis software and eye-tracking data will be tallied for when participants were viewing the primary or secondary task. The number of songs a participant finds during the driving task will also be tallied and NASA TLX scores as well as preferences will be compared.

5. EXPECTED RESULTS

It is expected that a significant increase in cognitive load, phone viewing time, and variance within the Lane Change Task (LCT) will be observed when drivers perform the search task with no auditory cues, as compared to a baseline where no search task is completed. Once auditory cues are applied within the search task it is expected that the cognitive load, phone viewing time, and variance in the LCT will decrease. Based on previous work [8], it is expected that the Spindex and Spearcon conditions will show the highest performance increase within the auditory cues as compared to no auditory. It is also expected that the number of songs found and selected during the drive will be higher during the trials with auditory cues.

6. IMPLICATIONS

Implications gained from this study could be highly applicable to decrease driver distraction in real driving. If the expected results do occur then it will provide further evidence that the application of auditory cues, specifically these types of auditory cues, can decrease the distraction in driving and searching on lists, whether it be songs, contacts, or other items on an electronic device.

7. ACKNOWLEDGMENTS

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