

Emotions, Driving and In-car Speech Based Information Systems

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ABSTRACT

Linguistic and paralinguistic cues such as choice of words, intonations and tone of voice all play a critical role in human-human human-computer interactions. Voices, both computer-generated and recorded, manifest personality, gender, and accents (Nass & Brave, 2005). While these characteristics give us a broad sense of what a person will think and do, predicting a person's behavior at any given moment in time also requires attention to the user's particular feelings, knowledge, and the physical situation of the person.

Attitude, behavior, and cognition also can be influenced by momentary states such as feelings and situation. The most powerful momentary state is emotion. Emotion is not limited to the occasional outburst of fury when a person insults you, excitement when one wins the lottery, or frustration when trapped in a traffic jam. It is now understood that a wide range of emotions play a critical role in activities ranging from asking for directions to asking someone on a date.

Although emotion was one of the primary foci of the early field of psychology, the study of emotion has lain dormant for a long time (Gross, 1999). This avoidance of the study of emotions has extended to the realm of voice interfaces. Just as users have emotions, interfaces can manifest emotions (Picard, 1997). Textual interfaces can exhibit emotion through word choice, pictorial interfaces can smile or frown, and voice interfaces can exhibit emotion through tone of voice. Cues such as loudness, fundamental frequency, frequency range, and speech-rate distinguish dominant from submissive individuals and affect people interacting with systems using computer-generated speech (Nass & Gong, 2000). It has also shown that most basic emotions or modes are associated with acoustic properties in a voice such as pitch range, rhythm, and amplitude or duration changes. For example, sadness is generally conveyed by slow and low-pitched speech, while happiness is associated with fast and louder speech.

Voice Interfaces in the Car

Introducing speech-based interaction and conversation into the car highlights the influence of linguistic and paralinguistic cues. Previous studies with in-car information studies showed that the linguistic cues had a significant

effect (Jonsson et. al, 2004). Emotional cues in speech interfaces have been studied in contexts other than the car and findings show that emotions or mood are detected and affect performance. Positive affective states favorably affect problem solving and decision making (Hirt et al. 1996; Isen, 2000). Emotions are also contagious: people often catch each other's emotions. An individual's current emotional state can also affect the experience of subsequent affective interactions. Residues from a previous affective reaction will combine with effects of emotions produced by subsequent affective stimulations. This can cause an overly intense affective reaction so that residual arousal from happiness may intensify their sense of well being, and residual unhappiness from sadness may intensify discomfort.

Driving presents a context in which emotion can have enormous consequences, since attention, performance, and judgment are of paramount importance in automobile operation, with even the smallest disturbance potentially having grave repercussions. The road-rage phenomenon (Galovski & Blanchard, 2004) provides one undeniable example of the impact that emotion can have on the safety of the roadways. Considering the above discussion of the effects of emotion—in particular, that positive affect leads to better performance and less risk-taking—it is not surprising that research and experience demonstrate that happy drivers are better drivers (Groeger, 2000). With the introduction of a voice in the car becomes critical to know how emotion expressed by an in-car voice interface interacts with a driver's emotion in affecting attention, performance, and judgment. Might the emotional characteristics of the voice have as much impact on attention, performance, and judgment as the emotion of the driver? More specifically, what happens when the emotion of the voice and the emotion of the driver are mismatched, e.g., an upset driver encountering an energetic and happy voice, or calm driver interacting with an upset voice?

Approach

To investigate the impact of car voices and emotions on driving, we setup driving simulator experiments. For these experiments, we cannot rely on participants being in a certain mood or exhibit a certain emotion so we use inducement techniques, audio, video, (Gross & Levenson 1995; Detenber & Reeves 1996) computer tasks (Stafford

2004), visualization tasks (Fessler et al, 2004) to ensure certain emotions. We also manipulate both the driving scenario and the in-car voices for emotional effect and content. Voice prompts are designed to vary both in linguistic and paralinguistic features such as 1) emotional colouring 2) familiar/unfamiliar voice 3) prompts that provide warnings and information on road conditions and 4) prompts that provide a conversational partner.

The data from these studies are evaluated both for driving performance, are the voice systems helpful, and attitude, are the voice system well liked and will hence stay turned on.

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