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How fleeting emotions affect hazard perception and steering while driving: The impact of image arousal and valence

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ABSTRACT

Video-billboards and portable video-display devices are becoming increasingly common and the images they project can often be dramatic or provocative. This study investigated the lingering effects of emotion-evoking images on driving as measured in a driving simulator. Images were projected on an in-vehicle display while drivers followed a lead vehicle at a safe distance. To ensure attention to the images drivers were required to indicate whether each image was positive or negative by pressing a button. Occasional braking events (sudden decelerations in the lead vehicle that necessitated braking) occurred either 250 or 500 ms after the button press. In the 250 ms delay condition braking RT was faster after high arousal images (fastest for high arousal positive images); following a 500 ms delay braking RT was *slower* after high arousal images (slowest for high arousal negative images). Responding to all images reduced steering performance (in the period after the image but before the button press) but image valence had an effect on steering as well. Positive images were associated with better steering performance than negative images, especially when they were both low in arousal: a result that supports the broaden-and-build hypothesis of positive emotions and the theory that ambient (wide field/peripheral) vision controls steering performance. We discuss implications for both basic research on attention–emotion and applied research on driving.

1. Introduction

Individuals may experience a variety of transient emotions while driving an automobile: exhilaration as the wheels hug the curves of a winding road; alarm as a semi-trailer drifts into their path; annoyance at a slow moving driver monopolizing the passing lane. Some emotions are inherent in the drive (Mesken et al., 2007) but others arise due to incidental events: energizing or calming music, dramatic or lurid images on billboards or video displays. Research suggests that emotion can have an impact on a wide range of human capacities, from muscle strength to memory (e.g., Schmidt et al., 2009; Anderson et al., 2006, respectively), but when driving, the moment-to-moment effects of emotion may produce immediate and disastrous consequences. Most often these consequences are not the products of road rage but rather those of momentary lapses in attention. Inattention is a factor in the majority of collisions and near-misses (e.g., Neale et al., 2005) and it is important to understand how emotion-evoking stimuli influence the ability to perceive and react to changing conditions on the road. This investigation is of relevance for the driving literature but it also has ramifications for basic research on emotion and attention.

Emotion is thought to involve at least two components (e.g., Colibazzi et al., 2010). One is valence, or how positive or negative the stimulus is. For example, generally a playful puppy is associated with positive valence whereas a snarling dog is associated with negative. The second component is arousal, or how exciting or stimulating the stimulus is. An erupting volcano may induce high arousal whereas a peaceful sunset usually induces lower arousal. Specific emotions are associated with different combinations of arousal and valence. For example, the high arousal positive valence combination is associated with happiness or exhilaration. Low arousal positive valence is associated with peaceful contentment. High arousal negative valence is associated with threat (most commonly fear) and low arousal negative valence is associated with sadness or depression. Though valence and arousal are both important in emotion, evidence suggests they are processed in different areas of the brain (Colibazzi et al., 2010; Nielen et al., 2009). For example, in a functional magnetic resonance imaging study that involved showing participants images of different types, Nielen et al. (2009) found that showing high and low arousal images produced differential activity in the middle temporal gyrus, hippocampus, and ventrolateral prefrontal cortex. When participants were shown negative valence images it elicited activity in

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