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Emotion-laden stimuli influence our reactions to traffic lights

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ABSTRACT

This study focused on the effects of emotion-laden stimuli (emotional roadside advertisements) on driver decision making. A common dilemma in driving is whether to speed up or brake when the lights turn yellow at an intersection. This study focused on this aspect of driver decision making. We compared the influence of emotion-laden roadside advertisements (positive, negative, and neutral solutions) either on the evaluation of possible risk (i.e., evaluative behavior) or the decision to stop/speed up (i.e., urgent behavior). We showed that drivers brake more often after negative advertisements than after positive and neutral ones; at the same time, the response latency was shorter when they decided to speed up. We also demonstrated that urgent behavior responses were faster than evaluative ones, independent of the emotional content. Thus, we conclude that urgent behavior may be more automatic than evaluative behavior according to the dual system models of risk perception and decision-making. Overall, our results suggest that emotional factors play a decisive role in making driving decisions, particularly in risky driving situations. These findings provide important information for the development of new and advanced driver emotional support systems and, in general, for the specification of future transportation police design guidelines.

1. Introduction

Risk perception, as well as risky decision-making, is an essential part of our behavior when driving, especially in situations where a sudden reaction is required and a wrong decision or a slow response could lead to serious consequences (Megías, Maldonado, Cándido, & Catena, 2011). A clear example is when a traffic light turns yellow just as a driver approaches an intersection (i.e., the dilemma zone). In this situation, drivers have to perceive whether there is a potential risk and either stop suddenly to avoid entering the intersection or *continue straight across the traffic light* junction; in some cases, drivers speed up rapidly to try to clear the intersection. These actions could be potentially dangerous, and it is well known that sudden reactions are a frequent cause of accidents (Lee, Llaneras, Klauer, & Sudweeks, 2007). When a driver brakes suddenly because a traffic light turns yellow, the driver behind him also has to brake hard to avoid a collision. The decision of braking in this situation is a function of several variables, including vehicle-related (e.g., cruising speed), environment-related (e.g., distance from the intersection), and driver-related (e.g., emotional state) factors (Cacciabue, 2007; Caird, Chisholm, Edwards, & Creaser, 2007; Konecni, Ebbesen, & Konecni, 1976). Research on road safety has largely investigated most elements of this

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complex interaction (Cacciabue, 2007). However, the driver's emotional state and its impact on safety behavior are not well understood (Serrano, Di Stasi, Megías, & Catena, 2013). In this study, we explored the influence of emotional impact upon driving behavioral responses, including both risk perceptions and risky decisions, when a traffic light suddenly turns yellow.

In general, emotional influence on driver behavior has been considered to be caused both by the previous emotional state of the person (mood) and by the emotions generated by stimuli presented while driving (SWOW, 2010). Emotions and moods are closely related concepts, yet they involve significant differences. Moods are considered stable affective states not related to a particular object and are triggered in contexts unrelated to the current information-processing situation. In contrast, emotions are usually intense transitory reactions that fluctuate in valence and level of arousal over short time periods; emotions arise in reaction to a particular object or event present in the situation itself (Bodenhausen, Mussweiler, Grabriel, & Moreno, 2000; Davidson et al., 1994; Frijda, 1993). Although this important distinction has not been frequently acknowledged in the traffic research literature (Arnett, Offer, & Fine, 1997), we think that given the different characteristics of both concepts, it should be an important point to note. In traffic, moods are affective states independent of the traffic situation, for example, driving in a depressed mood (Megías, Maldonado, Catena, & Cándido, 2012; Mesken, 2006, for an extensive review); in contrast, emotions are elicited by an event or object in the current situation. In this work, we focus on the influence of emotion-laden stimuli on driving behavior.

Several road elements or situations, such as seeing an accident, roadside memorials, or billboards, looking at or engaging in a dangerous maneuver, speech messages from warning alert systems, or being in a traffic jam have been shown to induce emotional responses in the driver (Megías, Maldonado, Catena, et al., 2011; Serrano et al., 2013; Tay, Churchill, & de Barros, 2011). Recent research has shown that driving while emotionally aroused could be a source of interference (Di Stasi et al., 2010; Pêcher, Lemercier, & Cellier, 2009; Serrano et al., 2011). Di Stasi and colleagues (Di Stasi et al., 2010), by displaying emotion-laden collision avoidance signals, induced unsafe driving behavior instead of increasing road safety. Similarly, Megías, Maldonado, Cándido, et al. (2011) focused on visual stimuli and showed that emotion-laden stimuli, especially negative ones, impaired the driver's hazard discriminability in risky situations. More specifically, Megías, Maldonado, Catena, et al. (2011) presented emotion-laden roadside advertisements through a driving simulator and observed important changes in the driver's behavior, diverting the driver's attention from the relevant region for driving. Furthermore, research has also shown that mood and emotion can modulate risk proneness (Mesken, 2006). This modulation can be accounted for by Forgas' affect infusion model (Forgas, 1995) and Bower's associative network theory (Bower, 1981). Both models predict that when individuals are involved in a judgment or a decision-making process, it is easy to attend to the process and retrieve information that agrees with their actual emotional state. Thus, drivers in a negative mood are more likely to consider the negative aspects of risky situations and perceive more unfavorable consequences, thus reducing their risk proneness level.

In addition, most research on the influence of emotions on behavior has focused on the manipulation of contextual (e.g., frame, see Slovic, Finucane, Peters, & MacGregor, 2004) and specific factors, as discussed above (e.g., type of moods, see Mesken, 2006 or Pessoa, 2009). Little attention has been devoted to determining whether the effects of emotions can be influenced by the task's features (e.g., type of behavior required). In this vein, Megías' urgent-evaluative behavior distinction (Megías, López-Riañez, & Cándido, 2013; Megías, Maldonado, Cándido, et al., 2011) has proven to be important in understanding the emotional modulation of behavior. Urgent behaviors are triggered by the stimulus and performed under high time pressure. When successful, urgent behaviors help to avoid highly negative outcomes (e.g., to decide to brake in a risky situation). On the other hand, evaluative behaviors are considered a type of categorization process (e.g., to classify a road scene as risky or not) of what is typically performed by an observer. According to the dual process models (Loewenstein, Weber, Hsee, & Welch, 2001; Slovic et al., 2004), urgent behaviors are largely controlled by the affective-experiential system, while evaluative behaviors are under the control of the rational–analytic system. Megías, Maldonado, Cándido, et al. (2011) showed that urgent behaviors (to brake) are considerably faster and have a response bias towards more conservative responses than evaluative ones (risk evaluation). Negative and positive cues slowed down the braking response, but negative cues tended to speed up the risk evaluation. Moreover, lower discriminability indices were only found after emotional cues in the urgent condition. These results support the existence of a task-feature modulator effect.

In summary, the extensive literature on the influence of emotions in decision making (Pereira et al., 2010; Slovic et al., 2004), and more specifically, about its modulation of risk decision-making (Chou, Lee, & Ho, 2007; Loewenstein et al., 2001), indicate that emotion should affect both the perception of risk and the subsequent decision-making while driving (Averty, Collet, Dittmar, Aathènes, & Vernet-Maury, 2004; Groeger, 2000; Megías, Maldonado, Cándido, et al., 2011). This research study aimed to identify how emotion-laden visual stimuli (negative and positive valence), presented incidentally on the road while driving, influence the risk perception (evaluative behavior; e.g., to evaluate risk) and decision-making (urgent behavior; e.g., to brake in a risky situation) during simulated driving situations, such as a traffic light turning yellow at an intersection with and without potential risk. Predictions about emotion-laden stimuli effects compared to the neutral condition can be focused in different directions (Di Stasi et al., 2010; Mesken, 2006). Following the proposed framework, we hypothesized that after observing negative-laden stimuli, drivers would show a lower risk proneness level due to the perception of more unfavorable consequences compared to positive and neutral stimuli. Moreover, according to the dual system models, faster and more conservative responses should be related to urgent behaviors combined with a possible task-feature modulator effect on the influence of the emotional stimuli (Megías, Maldonado, Catena, et al., 2011; Megías, Maldonado, Cándido, et al., 2011).