How appraisals shape driver emotions: A study from discrete and dimensional emotion perspectives

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ABSTRACT

This study aimed to investigate how the emotional responses of drivers, from both dimensional and discrete perspectives, may be predicted by using the appraisal components of goal relevance, blame party, and certainty. Traffic scenarios representing a combination of the three appraisal components were designed and presented to participants. The emotional responses to each scenario were measured on an Arousal–Valence emotional space and were assigned with discrete emotion labels by applying a cluster analysis. For the dimensional model, the results showed that valence was significantly associated with the blame party and the goal relevance components. The arousal was, as hypothesised, predicted by the blame party and the certainty components. For the discrete model, it was found that driving anger was most likely to be provoked when other drivers were responsible for the adverse driving outcome; driving fear was most commonly experienced in situations where driver safety was threatened by the driver himself/herself or by impersonal circumstance; and driving anxiety was an outcome of uncertain arrival-blocking events caused by driver himself/herself or impersonal circumstance. Findings from this study suggest the feasibility of predicting emotional dimensions on the basis of the appraisal process. Moreover, this study contributes to the research on driver emotion by demonstrating that the certainty feature of traffic events plays an important role in determining the emotional responses of drivers.

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1. Introduction

Driving can provoke a large range of negative emotions such as anger, anxiety or fear. Using a two-week period driving diary, Underwood, Chapman, Wright, and Crundall (1999) found that 85% of respondents surveyed reported experiencing anger at least once while driving. Mesken, Hagenzieker, Rothengatter, and de Waard (2007) showed that within a one-hour driving period, participants on average experienced anxiety 2.6 times and anger 1.5 times. These negative emotions can adversely affect driving performance by interfering with cognitive activities such as attention (Schimmack & Derryberry, 2005), evaluation (Evans, 2008), and decision-making (Morgan, Jones, & Harris, 2013). It has been found that drivers are more likely to violate speed limits when they feel angry (Stephens & Groeger, 2011) or anxious (Briggs, Hole, & Land, 2011). Moreover, aggressive behaviors such as tailgating or running amber lights have been demonstrated to be related to anger (Abdu, Shinar, & Meiran, 2012; Beck, Daughters, & Ali, 2013), and driving errors and lapses are related to fear

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and anxiety (Shahar, 2009; Taylor, Deane, & Podd, 2007). There is also evidence that accident risk increases for angry or anxious drivers (Dula, Adams, Miesner, & Leonard, 2010; Underwood et al., 1999).

1.1. Determinants of emotions: appraisal theory

To decrease the adverse impacts associated with negative emotions while driving, it is important to understand why and how drivers are provoked emotionally by certain traffic events. Appraisal theory provides a theoretical framework that describes how emotions are determined by how a driver evaluates an event (Roseman, 1996). According to Roseman (1996), five appraisal components, namely, motivation consistency, blame party, certainty, situational state, and legitimacy, are critical in the emotion generation process, with the first three being the most significant. The appraisal of motivation consistency refers to the evaluation of whether an individual's goal is promoted or blocked in a given situation and such an appraisal helps to differentiate positive from negative emotions. Positive emotion will be provoked in goal-promoting situations and negative emotion provoked in goal-blocking situations. The blame party refers to whether an outcome is seen to be caused by impersonal circumstances, some other person, or the self. In general, sadness or shame are associated with self-blame events; anger or dislike tend to be the emotional responses to other-blame events; fear or anxiety are most likely to be provoked when impersonal circumstances are held accountable (Roseman, 1996). The appraisal of certainty is the evaluation of whether the outcomes of events can be predicted or not and it can further differentiate emotion such as fear and anxiety. According to Sadock, Kaplan, and Sadock (2007), fear is an emotional response to certain or known threats while anxiety is a response to uncertain or unknown threats. Roseman's appraisal theory has been supported by a lot of research and there is evidence that appraisal outcomes are the key to predicting emotional response patterns (Conati & Zhou, 2002; Gratch, Marsella, Wang, & Stankovic, 2009).

In recent transportation research, the emotional responses of drivers to traffic events have been investigated from the perspective of appraisal theory. In a study where participants drove an instrumented vehicle and reported their emotions, Mesken et al. (2007) found that negative emotions were associated with goal incongruent events while happiness was associated with goal congruent events. They also found that goal relevance, which referred to achieving the two most important goals in traffic situations (i.e. arrival at the destination and safe driving), partially determined the type of emotions provoked. Anger was mostly triggered by progress-impeding events while anxiety associated with safety-threatening events. Similar findings have also been reported by Roidl, Frehse, Oehl, and Höger (2013) in their questionnaire studies. The importance of goal relevance in shaping the emotional responses of drivers has been further supported by Zhang and Chan (2014), where it was found that drivers become angrier when their safety is threatened than when their progress is blocked. Regarding the effects of blame party, it has been shown that driving anger is mostly associated with other-blame and anxiety with circumstance-blame (Mesken et al., 2007; Roidl et al., 2013).

It is evident that all previous driver emotion studies have only focused on goal relevance and the blame party. The effect of the certainty appraisal component on the emotion generation process of drivers has not been explored much even though the outcomes of many traffic events are unpredictable (Hault-Dubrulle, Robache, Pacaux, & Morvan, 2011). For instance, drivers can usually predict how long they will be blocked by red traffic lights, but it is difficult for them to estimate how long traffic congestion may last. It seems like that drivers will develop rather different emotional responses to these two situations, though both of which are arrival-blocking events caused by impersonal circumstances. Therefore, it is necessary to take the certainty component of traffic events into consideration to better understand and more accurately predict the emotional experiences of drivers. One aim of this study was to investigate how the combinations of the three most relevant appraisal components (goal relevance, blame party, certainty) determine the type of emotions experienced by drivers in given traffic scenarios.

1.2. Emotion experience measures: discrete and dimensional approaches

Psychological emotion models developed by previous researchers can be categorized into two main groups; one with discrete emotion states and the other with emotions expressed in a dimensional continuous space. In the discrete emotion models, human emotions can be classified into a prescribed list of words or adjective labels, e.g. happiness, anger, etc. (Ekman, 1999; Thamm, 2006). The dimensional space approach contends that a few fundamental dimensions together specify emotional responses (Colibazzi et al., 2010) and the most recognised dimensions are valence and arousal. Valence refers to a subjective feeling of pleasantness or unpleasantness, and arousal is defined as a subjective state of feeling activated or deactivated. With the purpose of better accounting for differences in emotional experiences, new emotion dimensions, such as the submissive-dominance dimension (Bradley & Lang, 1994) or the approach-avoidance dimension (Davidson, Ekman, Saron, Senulis, & Friesen, 1990), have been proposed. However, these newly proposed dimensions seem to explain only a small proportion of the variance in emotion and are less consistently accepted by emotion researchers than valence and arousal (Scherer, Dan, & Flykt, 2006). By proposing that a discrete emotion represents a combination of several dimensions, it is possible to reconcile the two perspectives to some extent (Mauss & Robinson, 2009). The locations of discrete emotions within the dimensional continuous space have been investigated in a number of psychological studies aiming to integrate the two emotion models (e.g. Christie & Friedman, 2004; Sun, Yu, Huang, & Hu, 2009). Their findings suggest that dimensions of valence and arousal can portray the structure of discrete emotions. For example, anger is found to be characterized by high arousal and extremely negative valence, whereas anxiety characterized as low arousal and less negative valence.