The effects of instruction and environmental demand on state anxiety, driving performance and autonomic activity: Are ego-threatening manipulations effective?

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A R T I C L E   I N F O

A B S T R A C T

A small yet emerging body of research on the relationship between anxiety and driving suggests that higher levels of state anxiety may lead to more dangerous driving behaviours. The aim of the current research was to investigate the effects of increased state anxiety on driving behaviours within a simulated environment using instructional sets to manipulate anxiety levels. In Study One, whilst a set of safety-related instructions were able to increase state anxiety, this did not result in changes to driving behaviours. In Study Two, ego-threatening instructions were not able to successfully increase state anxiety. This has implications regarding instructional sets in research, including their task relevance and the necessity for a motivational incentive. However, when changes in anxiety were considered regardless of instruction group, Study Two found changes in SDLP and skin conductance levels related to state anxiety increases. As these effects were context specific, it is argued that some of these changes may be due to poorer processing efficiency, leading to suggestions about the types of behaviours that may need to be trained in potential therapies for those who show high state anxiety levels whilst driving.

1. Introduction

Recent research has shown that emotions can play a significant role in increasing the likelihood of dangerous driving behaviours and crashes. There has been a particular focus on the role of anger, or road rage. It has been consistently suggested that increases in anger can lead to a greater likelihood of aggressive behaviours (Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000), which can include physical violence and verbal aggression. It has also been associated with less safe driving behaviours (Deffenbacher, Lynch, Filetti, Dahlen, & Oetting, 2003) and an increase in traffic violations and fines (Gonzalez-Iglesias, Antonio Gomez-Fraguela, & Angeles Luengo-Martin, 2012).

However, it has also been noted that multiple emotions associated with negative affect can lead to more dangerous driving behaviours (Dula & Geller, 2003); one example of this is anxiety. Anxiety is described as a feeling of tension or unease at the prospect of a threatening, but not guaranteed, event (Rachmann, 2013). It can be measured and researched as a clinically diagnosed disorder, as a general trait, or as a state. Changes in those who are more anxious, in comparison to other negative emotions, include greater attentional biases towards threat (Bradley, Mogg, Falla, & Hamilton, 1998; Bradley, Mogg, & Millar,

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2000) and increases in sympathetic arousal, which are indexed by increases in skin conductance levels (Globisch, Hamm, Esteves, & Ohman, 1999; Kissel & Littig, 1962).

Whilst it has not been as extensively researched as anger, it is argued that there should be an increase in research investigating the relationship between anxiety and driving. On-road research has suggested it is one of the more frequently reported emotions, in comparison to anger and happiness (Mesken, Hagenzieker, Rothengatter, & de Waard, 2007). Moreover, recent UK statistics suggest that in 2015 over 1800 crashes, 16 of which were fatalities, were caused due to the driver feeling nervous, uncertain or panicked (Department for Transport, 2016). This suggests that feeling anxious whilst driving may lead to changes that could indicate or result in accident risk. On-road research may provide support for this suggestion. For example, Mesken et al. (2007) found increases in self-reported anxiety were associated with increases in heart rate. Based on the literature on the relationship between heart rate and driving (Lenneman & Backs, 2009; Mehler, Reimer, & Coughlin, 2012), this could suggest that levels of demand are too high for those with higher levels of anxiety. One study observed participants' levels of state anxiety whilst completing mock and real versions of the British Driving Test, and found that those higher in state anxiety not only had a higher heart rate, but were more likely to fail their real test (Fairclough, Tattersall, & Houston, 2006).

The fact that participants with higher state anxiety were more likely to fail their driving test suggests that anxiety may result in behaviours that make a person too unsafe to independently drive on real roads. However, it is worth noting that for ethical purposes, on-road research often requires the presence of an additional researcher in the car. This in itself may unintentionally increase state anxiety levels. On this basis, it may be more of an advantage to complete research into anxiety's effects on driving within a simulated environment. Additionally, if it is hypothesised that someone with higher levels of state anxiety will behave more dangerously on the roads, then it is safer to test this in an environment where the risk of harm to themselves or others is minimal. Whilst it is acknowledged that the choice of simulator or participants may impact the resulting validity of observed driving behaviours (Mullen, Charlton, Devlin, & Bédard, 2011), simulator research has often demonstrated that higher levels of reported state anxiety result in changes including reduced horizontal scanning (Briggs, Hole, & Land, 2011), increased reaction times to respond to traffic lights (Salvia et al., 2012), and a higher frequency of speeding violations (Roidl, Frehse, & Hoeger, 2014).

One method that is commonly used to increase levels of state anxiety, prior to completing a driving simulator task, is to provide participants with a task or set of anxiety-relevant instructions. For example, one study asked participants to spend five minutes describing their least favourite body part, whilst a comparison group were given five minutes to listen to relaxing music (Morton & White, 2013). Results suggested that whilst the task was sufficient in increasing levels of anxiety, it only resulted in one behavioural change, which was an increased time to brake at pedestrian crossings. Other studies using similar methods to induce emotional states have found the manipulation to be a success without any subsequent changes in driving behaviour (Jeon, Walker, & Yim, 2014). This could lead to the conclusion that whilst the tasks given are anxiety-provoking, they may not be strong or relevant enough to transfer to the actual driving situation. Tasks that have found changes in behaviour as well as increases in state anxiety have often used instructional sets designed to promote competitiveness. In such studies, participants are told prior to completing a task that their results will be placed in a league table alongside others. Studies that used these instructions suggest that drivers are less proficient at processing information (Murray & Janelle, 2003), have significant increases in heart rate (Mullen, Faull, Jones, & Kingston, 2012), and increases in pupil diameter which suggest that the task becomes more effortful for the driver (Wilson, Smith, Chattington, Ford, & Marple-Horvat, 2006).

The aim of the two studies in this paper was to investigate the effects of task-relevant instructional sets on state anxiety, and its subsequent effects on driving behaviour in simulated environments. In the first study, a set of safety-related instructions were provided to participants before they completed two motorway driving tasks. In the second study, a set of ego-threatening instructions were provided before participants completed a series of drives in environments varying in visual complexity and vehicle handling levels. Both studies also included a final instruction informing participants their results would be placed in a league table alongside other participants in the study. As well as changes in driving behaviour, based on the aforementioned literature, measures of eye movements and skin conductance were also taken. The studies were conducted to provide research implications on the appropriate use of instructional sets in state anxiety research, theoretical implications on the behavioural, attentional and autonomic changes that may be associated with changes in state anxiety, and practical implications regarding specific driving behaviours that may need to be improved in response to state anxiety increases. Based on the previous driving and anxiety literature, it was hypothesised that relevant instructional sets would result in increases in state anxiety, and that this increase in state anxiety would in turn lead to changes that would indicate dangerous driving behaviours.

2. Study One

2.1. Methods

2.1.1. Participants

Thirty-eight undergraduate students participated in the study. They were aged between 18 and 26 years old (m = 19.7, sd = 1.66), and 25 were female. They had held a full licence for an average of 2.25 years (sd = 1.78) and reported driving