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Beware when danger on the road has passed. The state of relief impairs a driver's ability to avoid accidents☆

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ABSTRACT

A driver is often required to react adequately to sudden, dangerous situations. If the driver successfully negotiates the challenge, a state of emotional relief is then experienced that arises at the moment the strong fear dissipates. Previous experimental studies described in the psychological literature have shown that in a state of relief, people exhibit a decline in cognitive functioning. The article's authors posed the question of how well a driver functions in this unique state. They conducted research using an AutoSim AS 1200-6 driving simulator in two road conditions: outside the city and in urban driving conditions. In fear-then-relief conditions, a few seconds after the driver managed to avoid an accident, another difficult situation arose on the road. It was examined how frequently a collision takes place in such a situation in comparison to a group that did not experience a state of relief resulting from the avoidance of an earlier accident. It occurred that while being outside the city the likelihood of an accident grew with the speed at which the car was traveling. The state of relief, however, did not lead to any disruptions in a driver's functioning in those conditions. In urban driving conditions the likelihood was not, however, associated with speed. Yet the emotional condition of the driver was of importance. There was a nearly three-fold increase in the probability that the driver would fail to avoid an accident in fear-then relief conditions when compared to control conditions. This is entirely consistent with earlier studies demonstrating disruptions in the cognitive functioning of people experiencing relief. The practical implications of these results are discussed.

It is obvious that accidents happen primarily when a driver encounters a dangerous and unexpected situation on the road: a motorcycle suddenly joins traffic from an access road, a dog runs under the mask of the car, a large box that likely just fell off the back of a delivery truck lies on the asphalt just around a curve in the road, etc. Numerous important and valuable studies concerning drivers' performance in such situations have been conducted demonstrating that in such cases the likelihood of an accident increases (e.g., Hoffman et al., 2005; Owsley et al., 1991; Saxby et al., 2013).

In this article, however, we concentrate on a slightly different phenomenon. We ask how the experience of such an event influences a driver's performance in the period immediately thereafter. Indeed, after the appearance of sudden fear associated with a serious danger, a driver may experience a state of sudden relief resulting from the successful avoidance of the threat. Can this state of relief influence the performance of a driver?

As Lazarus (1991) noted, relief has received very little attention as a discrete emotion; however, its appraisal pattern and action program without any doubt qualify it as such. The relief state is unique as a positive emotion in that it occurs only after a goal-incongruent condition has been resolved. Thus, its eliciting condition may be considered the alleviation of a negative emotional state. It is unsurprising that the one research program that has directly considered the consequences of relief did so in the context of fear. Dolinski and Nawrat (1998) have conducted a series of experimental studies to show that when people experience the emotion of fear followed by its subsequent removal, they are more likely to comply with various requests.

For example, in one of the field studies, the participants were drivers who had parked their cars illegally (i.e. in a no-parking zone). A piece of paper was placed by the experimenters behind the windscreen wiper (where tickets are located) or on the door (unusual place). The cards placed behind the wiper were either real parking tickets (fear condition) or advertisements for shampoo (fear-then-relief condition). The card placed on the door contained advertisement only (control condition). Drivers who experienced relief from fear were more likely to comply with a request to fill out a burdensome questionnaire than those

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who remained anxious or those who were in the neutral mood (control group).

How can the psychological mechanism of compliance in the fear-then-relief state be explained? Dolinski and Nawrat (1998) refer to the assumption that each discrete emotion is an action-requiring program (e.g., Denny, 1991; Frijda, 1986). The main function of fear is to act as a signal of the real or potential danger. The fear program (body alert and increases cautiousness toward external surrounding) serves survival by generating various fight-or-flight responses. While such a reaction is usually adaptive for threatening surrounding, it ceases to be functional when the circumstances suddenly change – when the stimulus that justifies this emotion is withdrawn. In such a situation of unexpected cancellation of a "state of emergency" people experience disorientation and may behave mindlessly. They adopt simplified heuristic processing and react in an automatic and thoughtless way to external stimuli. This interpretation is supported by the results of many experiments by Dolinski and Nawrat (1998), Nawrat and Dolinski (2007), Dolinski and Szczucka (2012, 2013) and Dolinska and Dolinski (2014). There is also direct empirical evidence that cognitive functioning is impaired in individuals who experience relief from fear. For example, in one study (Dolinski et al., 2002, exp. 4) it was demonstrated that in a condition of relief from fear, people make more errors when adding several two-digit numbers in their head. In another experiment, participants were shown a tableau of 72 photographs of human faces. On all of the faces, save for one wearing a smile, an expression of terror could be observed. The task of the participants was to identify as quickly as possible the face that expressed a different emotion from the remaining ones. As it turned out, participants who are in a condition of unexpected relief need more time to complete the task than did those in control conditions, as well as those who experienced induced fear without relief (Dolinski et al., 2002, exp. 3).

The findings mentioned above are in accordance with the functional emotion perspective, which suggests that "relief's subjective feeling is one of the release of muscle tension, and its associated tendency is one of inaction – a slumping of the body with the release of tension and cessation of vigilance," (Dillard & Pfau, 2002, p. 297).

It may be that conditions in which drivers manage to get through a dangerous situation safe and sound (such as by managing to brake in front of a motorcyclist who has cut the driver off, avoid a stray dog, swerve around a box on the road or some other unexpected impediment) they also experience the fear-relief sequence. If this is the case, we may suspect that a driver's cognitive functions in the condition of relief will (likely for a short time) be disrupted. By the same token, that driver's capacity to react to dangerous road conditions may be reduced. In order to test this, we decided to use a driving simulator in laboratory conditions to create the following scenario: a driver avoids one accident owing to driving skills, yet a short time later must again face an unexpected event on the road. We compared the performance of drivers in that situation with the behaviour of drivers who only experienced the latter unexpected event.

We assumed that drivers in a condition of sudden relief would function worse in both cognitive terms (disruption of attention focus) and in motor functions (delayed reaction to danger). Therefore, we formulated the hypothesis that if a threating road situation occurs, drivers experiencing a condition of relief would be less likely to avoid an accident than drivers in control conditions (*id est* not experiencing a condition of relief). In other words, we assumed that the earlier avoidance of an accident should result in worse chances of avoiding an accident during a subsequent incident. Additionally, we decided to test drivers' performance in two common situations encountered on the road: driving outside city limits ("outside the city") and driving within city limits ("in the city"). These situations are distinct both by the permissible speed (much higher in extra-urban consitions) and the perceptual complexity of the external situation (far more stimuli in urban conditions). In extra-urban conditions, a relatively uniform landscape dominated both sides of the road, while in urban conditions the architecture of the surrounding buildings changed, people were walking along pavements, etc. We did not formulate any particular hypotheses as to which of those situations may be more or less threatening for a driver experiencing a state of unexpected relief.

1. Method

Driving data were gathered in an AutoSim AS 1200-6 driving simulator based at the Motor Transport Institute in Warsaw, Poland. The simulator is a fixed-base Opel Astra IV. It has Dolby surround sound and a 200-degree field of view derived from image projection onto four screens. The simulator is equipped with a steering wheel, gas, brake and clutch pedals, manual gear shift, side mirrors and rear projection to provide a highly realistic driving environment. The simulation is interactive and driving events occur in real time.

1.1. Participants

Experiment participants were non-professional but experienced drivers, as a necessary condition for recruitment was an average annual distance travelled behind the wheel of 10,000 km (6213 miles). They had experience in driving both in urban and non-urban conditions. The experiment was performed with the participation of 47 men and 13 women, with an average age of 33.67 years (SD = 8.25). Participants had normal vision or were using corrective lenses bringing their eye sight to normal and they were paid for their participation.

1.2. Procedures [1)]

After entering the simulator, each participant underwent a 10-minute test drive. Drivers were asked to accelerate to a speed of 100 km/h, then slow down to 40 km/h, and then to drive the vehicle at a speed appropriate for the rules of the road and road conditions. The participant was informed that they would be instructed as to which direction to take (which way to turn), and that all rules of the road should be respected. The test drive was performed on a motorway along a 10 km stretch of road. Following a short break the actual experiment began. The participant drove "outside the city" for around 2 min. The driver traveled along a road with one lane going in each direction. The width of the car was 181.4 cm (5 ft 11.4 in), and the width of the lane was 3.5 m (11 ft 4.8 in). On both sides of the road were shoulders and large green spaces (fields, pastures, grassland, individual trees, and along some segments a forest set further from the road), as well as occasional single-family houses. The road featured mainly straight segments, with a small number of gentle curves. Because there were no road signs displaying a speed limit, the rules of the road in Poland (where the study was conducted) meant that the speed limit was 90 km/h. (56 MPH). After a 30-second break, the participant then drove for around 4 min "in the city". Under these condition the width of the lane was 325 m (10 ft 7.96 in). In these conditions, the car crossed thorough several intersections, both with lights and without; there were pavements along the street with individual pedestrians walking down it, and the cityscape featured mainly buildings of a few to around a dozen stories. There were numerous road signs and markings on the surface of the street. In city conditions, the speed limit in Poland is 50km/h (31 MPH)

Participants were randomly selected and assigned to either fear-then-relief (N = 31) or control conditions (N = 29). In the first case, the participants twice (once "outside the city", once "in the city") were found in a condition of fear-then-relief, while in the case of the remaining participants (control conditions) the state of fear-then-relief was not evoked even once.

In the fear-then-relief conditions, upon completing half of the first drive ("outside the city") the participant was forced to deal with a quite dangerous road situation: the driver of a car in the opposite lane decided to pass a slower vehicle, which required the test participant to