4. Effects of emotions on optimism bias and illusion of control in traffic\(^5\)

4.1. Introduction

Anger is related to aggression in traffic, which in turn may lead to risky driving (e.g. Lajunen, Parker, & Stradling, 1998; Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000; Parker, Lajunen & Summala, 2002; Deffenbacher, Lynch, Filetti, Dahlen & Oetting, 2003). Anger may also lead to risk taking behaviour through other processes than aggression. Although evidence for the link between anger and risk exists in areas outside traffic (Lerner & Keltner, 2001; Lerner, Gonzalez, Small, & Fischoff, 2003), the research that has been carried out in the area of traffic is mostly correlational and therefore leaves space for alternative explanations. For example, Arnett, Offer and Fine (1997) showed that people who are in an angry state exceed the speed limit to a greater degree than people who are not angry. This might imply that an angry state leads to speeding behaviour. An alternative explanation is that certain types of people are more inclined to both experience anger and to exceed the speed limit. For example, Sensation Seeking (defined by Zuckerman (1994) as “the need to seek novel, varied, complex and intense sensations and experiences”) has been associated with both anger (Zuckerman, 1994; Iversen & Rundmo, 2002) and risk (Jonah, 1997; Jonah, Thiessen, & Au-Yeung, 2001; Iversen & Rundmo, 2002; Roberti, 2004). If anger has a direct effect on risky driving, it is also possible that other emotions have a direct effect on driving. In studies on emotions and driving, effects of other emotional states have not received much attention. In the present study, the effects of anger and other emotions on cognitive processes related to risk were investigated.

Two types of emotion effects on performance can be distinguished. Emotion may consciously trigger actions or action tendencies (Frijda, 1986), as is the case in aggression, or emotions may cause a bias in cognition (Clore & Gasper, 2000). A number of cognitive processes may be influenced by emotions, for instance memory (Parrot & Spackman, 2000) and social

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judgement (Forgas, 1995, 1998). Not all of these processes are related to risk taking behaviour and as such relevant for traffic safety. Two cognitive processes that are related to risk can be distinguished: optimism bias and illusion of control. Optimism bias refers to the extent to which people are biased about their chances of getting involved in good or bad events. The term was first described by Weinstein (1980). In two studies, Weinstein showed that people rate their chances to experience positive events as higher than average and their chances to experience negative events as lower than average. It is important to keep in mind that optimism bias can only be determined at group level. An individual person may rate his or her risk as lower than average and may actually be correct. However, on a group level, it is unlikely that the risk of the majority is below average.

Optimism bias has also been shown to be present in road user behaviour. Svensson, Fischhoff and McGregor (1985) showed that drivers perceive themselves as less likely to be involved in an accident than other drivers. DeJoy (1989) showed similar findings: drivers rated their overall accident likelihood, and their likelihood of specific accident situations, as lower compared to the average driver. There were, however, differences across specific accident situations: optimism bias was stronger when personal control was high. Obviously, people feel that certain types of accidents are less likely to happen to them, because they have specific skills that prevent these accidents from happening. This bias in self-assessment was also shown by Svensson (1980) and Svensson et al. (1985).

Obviously, perceived control is an important aspect of optimism bias, although DeJoy found the optimism bias to be present in accidents beyond one’s control as well. Mckenna (1993) tried to clarify the relation between optimism bias and illusion of control. He found that the optimism bias disappears when taking illusion of control into account. It should be noted that the concept of illusion of control originally referred to a different phenomenon. Langer (1975) used illusion of control to refer to situations in which the control is in fact absent. In traffic related studies, the concept is mostly used to refer to situations where the control is genuine, but the benefits of the control are illusory. Horswill and McKenna (1999a, 1999b) found differences in preferred speed when people were asked to imagine they were driving themselves, and when people were asked to imagine they were a passenger. As drivers, people accepted higher speeds than as passengers, presumably because as passengers they thought their hypothetical driver was less able to cope with higher speed than themselves. The control as a driver is genuine, but this control does not necessarily lead to a decreased risk level. Thus, it is important to distinguish the concepts of
optimism bias “it won’t happen to me”, bias in self-assessment (“I am more safe and skilful a driver than others”) and illusion of control (“if it happens to me, I will be able to minimise the consequences”).

Several studies showed relations between emotions and cognitive processes related to risk. Dewberry and Richardson (1990) and Dewberry, Ing, James, Nixon and Richardson (1990) showed an inverse relationship between anxiety and optimism bias: people who were more anxious about negative life events were less inclined to be unrealistically optimistic. The authors state that anxiety, and negative affect in general for that matter, reduces optimism. Alloy and Abramson (1979) and Alloy, Abramson and Viscusi (1982) investigated the relationship between emotions and illusion of control. They found that depressed persons are less vulnerable to the illusion of control than non-depressed persons. Lerner and Keltner (2001) found opposing effects of fear and anger on risk perception: angry respondents rated situations as less risky than fearful respondents. Hemenover and Zhang (2004) showed that anger is related to optimistic evaluations, which is contrary to the conclusion of Dewberry et al. that general negative affect reduces optimism. The last two studies used the appraisal tendency framework (Lerner & Keltner, 2000) to explain emotion-specific effects on cognitive processes. According to this framework, people who are in a specific emotional state are likely to interpret other (not necessarily related) events in line with the emotions. For example, as anger is associated with a high level of perceived control, angry people will rate situations as more controllable and therefore less risky than non-angry individuals. Sad and fearful respondents will rate situations as less controllable and therefore as more risky, whereas happy persons will display the same pattern as angry respondents.

In the present study, the effects of anger and other emotions on cognitive bias were investigated in traffic behaviour. In two experiments, an experimental design was used in which subjects were asked to evaluate a series of traffic situations in a pretest and posttest. Some of the subjects received an emotion induction procedure between pretest and posttest; others did not. Subjects who did and did not receive the emotion induction procedure were compared in terms of optimism bias and illusion of control. As the emotions that people experience and express in certain situations are different from person to person, two personality scales were included to measure these tendencies: the Trait Anger Scale (Spielberger, Jacobs, Russel, & Crane, 1983) and the Trait Anxiety Scale (Spielberger, Gorsuch, & Lushene, 1970). Trait anger is defined as the frequency in which people get angry: people high in trait anger have a disposition to interpret a wide range of
situations as anger-provoking. Trait anxiety is defined as the degree to which a person responds to situations with apprehension and uneasiness.

4.2. Study 1

4.2.1. Method

The general design of the study was a pretest-posttest design with two experimental groups and one control group. The order of the tasks was the same for all three groups and included first a computer task in which video fragments were judged and questions were answered (pretest), a test drive in a driving simulator (which served as the emotion manipulation) and a second computer task with video fragments and questionnaires (posttest). In Table 4.1 the design of the study is portrayed.

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<thead>
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<th>Time = 1</th>
<th>Time = 2</th>
<th>Time = 3</th>
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<tbody>
<tr>
<td>Positive emotion group (n = 22)</td>
<td>Pretest</td>
<td>Emotion induction</td>
<td>Posttest</td>
</tr>
<tr>
<td>Control group (n = 21)</td>
<td>Pretest</td>
<td>Emotion induction</td>
<td>Posttest</td>
</tr>
<tr>
<td>Negative emotion group (n = 38)</td>
<td>Pretest</td>
<td>Emotion induction</td>
<td>Posttest</td>
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Table 4.1. Design of study 1.

Respondents

Eighty-one volunteers were recruited via an advertisement in a local newspaper and via the respondents pool of the university. Respondents were told that during the experiment they would be asked to make a test drive in a driving simulator and evaluate traffic scenarios showed on video. The sample included 35 males (43.2%) and 46 females. The mean age was 35.8 years. All respondents were holders of a driving license. The average time that respondents held their driver license was 13.8 years. The percentage respondents that drove less than 5,000 km was 40.7%; 23.5% drove 5,000-10,000 km; 8.6% drove 10,000-15,000 km; 16.0% drove 15,000-20,000 and 11.1% drove more than 20,000 km.

Pretest

Questions were asked regarding general background information (age, gender, driving experience etc.). Trait anger and trait anxiety were measured using Dutch versions of Spielberger's Trait Anger Scale (Spielberger et al., 1983) and Trait Anxiety Scale (Spielberger et al 1970). A series of video
fragments was recorded using an instrumented car equipped with a video camera mounted behind the front window. The fragments showed a 2 x 2 lane highway from the camera car driver's perspective. In eight fragments the following distance to the lead car that was visible on the video fragments was varied. Three fragments showed the camera car overtaking another car on the inside. The last fragment showed the camera car drive through amber lights on a crossing. Each video fragment was shown on the computer screen for about 15 seconds. After each video fragment, questions were asked regarding risk perception ("How safe or unsafe do you evaluate the situation?"), optimism bias ("Compare yourself to the average driver. Do you have more, less or the same chance of getting involved in a (near)accident in this situation?"), illusion of control ("Say, the driver in front of you hits the brakes suddenly. How likely is it that you are able to react in time in this situation?"), and behaviour intention ("How likely is it that you would drive like the driver in the video?"). Respondents answered these questions by using a 7-point rating scale, in which the lowest score meant unsafe (risk perception), more chance (optimism bias), and not likely (illusion of control and behaviour intention).

**Posttest**

In the posttest, respondents were asked to view the same video fragments and answer the same accompanying questions as in the pretest. Immediately after this, emotional state was measured using a slightly modified and translated version of Izard's Discrete Emotions Scale (Izard, 1977). The DES subscale of disgust was left out because it was not believed relevant for judgement in traffic. Remaining subscales were: anger, happiness, fear, sadness and surprise. Finally, questions were asked regarding general optimism bias and illusion of control in a range of traffic situations (not related to the situations on video).

**Emotion induction and procedure**

The respondents were divided in three groups: positive emotion group (n = 22), control group (n = 21), and negative emotion group (n = 38). The number of respondents in the negative emotion group was larger than in the other groups, because it was expected that the emotion manipulation would induce mostly anger in some respondents, but mostly disappointment / sadness in others. By using a higher number of respondents, these different negative emotions could be distinguished.

Respondents were tested individually. Once they arrived in the laboratory the procedure of the study was explained. Then, they were placed in front of the computer and were asked to answer the questions that appeared on the
computer screen: first background questions, second items regarding trait anger and trait anxiety, and finally the video fragments and accompanying questions. The video fragments were shown in random order. After finishing the task, respondents were asked to take place in the driving simulator that was present in the same laboratory. After explanation of the driving simulator and a test drive, respondents were asked to drive a previously designed route. The route had a fixed duration of 15 minutes for each group. However, the respondents were unaware of this. The instruction the respondents received was different for the three groups.

The first group, the 'positive emotion condition', received the following instructions: 'You are now going to make a test drive in the driving simulator. Results from previous studies show that 80% of all respondents is able to finish the drive in 20 minutes. If you are able to do so as well, you receive a 5 euro reward. However, if you are faster, you gain 1 euro per minute that you are faster. The maximum reward is 10 euros: this amount you will receive if you drive the route within 15 minutes.' The route for the positive emotion condition was designed in a way that caused a minimum of frustration. The traffic was light and there was no waiting time for traffic lights. After finishing the driving task, respondents were told that they had performed well: they had driven the route within 15 minutes and they therefore received the 10 euro reward. Then, they were asked to sit down in front of the computer to finish the second series of questions.

The 'negative emotion condition' received the following instruction: 'You are now going to make a test drive in the driving simulator. Results from previous studies show that 80% of all respondents is able to finish the drive in 10 minutes. If you are able to do so as well, you receive a 10 euro reward. However, if you are slower, you lose 1 euro per minute that you are slower. The minimum reward is 5 euros: this amount you will receive if you drive the route within 15 minutes.' The route was designed in a way that caused a lot of frustration: traffic was dense, waiting time for making left turns was long, and several times progress was impeded because another driver was driving slowly where overtaking was not possible. After finishing the driving task, respondents were told that they had been too slow: they had driven the route in 15 minutes and they therefore received only 5 euros reward. Then, they were asked to sit down in front of the computer to finish the second series of questions.

The control group was told in the beginning of the experiment that the reward was 10 euro. Before starting the test drive in the simulator, respondents received the following instruction: "You are now going to make
a test drive in the driving simulator. The designed route takes about 15 minutes to finish.” The route was designed in a way that did not cause a particular amount of frustration but was not extremely easy either. Traffic was moderately dense.

After the emotion manipulation in the driving simulator, respondents were again asked to sit in front of the computer to answer the second series of questions. First, the same video fragments as were shown in the pretest were shown and respondents were requested to answer the accompanying questions. Then, the manipulation check was carried out using Izard’s (1977) Discrete Emotions Scale. Finally, questions regarding general optimism and illusion of control were asked. When respondents were finished, a thorough debriefing was carried out in which all aspects of the experiments were explained and the reward (10 euro for all groups) was paid.

4.2.2. Results

Manipulation check
No significant differences on the 15 emotion items were found between the three groups. Possible interfering effects of gender, age, trait anger and trait anxiety were checked but still the groups did not differ on emotional state. In general, respondents hardly reported any negative emotions, regardless of the condition. For example, on a five point scale, the means for "annoyed" were 1.4 (positive emotion group), 1.2 (control group) and 1.4 (negative emotion group). Likewise, the means for "disappointed" were 1.5 for all three conditions. Therefore it was not possible to make comparisons between the groups.

Difference between pretest and posttest
The scores on risk perception, optimism bias, illusion of control and behaviour intention were recoded, so that low scores meant respectively 'not safe', 'more likely to have an accident than the average driver', 'little control' and 'not likely to drive like that'. The video fragments were evaluated differently in the posttest than in the pretest. Subjects evaluated the fragments as more safe in the pretest (M = 34.8) than in the posttest (M = 32.4; \( T_{\text{pairwise}} = 3.6, p < 01 \)). Subjects rated the chance to get involved in a (near) accident, compared to the average driver, as lower in the pretest (M = 42.1) than in the posttest (M = 40.7; \( T_{\text{pairwise}} = 3.2, p < 01 \)). Also, subjects evaluated the fragments as more controllable in the pretest (M = 38.2) than in the posttest (M = 36.0; \( T_{\text{pairwise}} = 2.9, p < 01 \)). No differences between pretest and posttest appeared for behaviour intention. Thus, for three out of four
dependent variables, respondents were more cautious in their evaluation in the posttest compared to the pretest.

**Additional analyses**
To investigate if people scoring (relatively) high on positive or negative emotions made different judgements than respondents scoring low on these emotions, some exploratory analyses were carried out. First, a factor analysis (principal components analysis with varimax rotation) was performed on the 15 emotion items (see Table 4.2). Second, the video judgements of respondents scoring high on the different factors were compared with respondents scoring low on these factors.

<table>
<thead>
<tr>
<th></th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
<th>Factor 4</th>
</tr>
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<tbody>
<tr>
<td>Angry</td>
<td>.87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downhearted</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Disappointed</td>
<td>.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frustrated</td>
<td>.76</td>
<td>.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sad</td>
<td>.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annoyed</td>
<td>.47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surprised</td>
<td></td>
<td>.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amazed</td>
<td></td>
<td>.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marvelled</td>
<td></td>
<td>.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nervous</td>
<td></td>
<td></td>
<td>.89</td>
<td></td>
</tr>
<tr>
<td>Scared</td>
<td></td>
<td></td>
<td>.83</td>
<td></td>
</tr>
<tr>
<td>Concerned</td>
<td>.53</td>
<td>.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Happy</td>
<td></td>
<td></td>
<td></td>
<td>.83</td>
</tr>
<tr>
<td>Satisfied</td>
<td></td>
<td></td>
<td></td>
<td>.67</td>
</tr>
<tr>
<td>Relieved</td>
<td></td>
<td></td>
<td></td>
<td>.58</td>
</tr>
</tbody>
</table>

*Table 4.2. Factor Analysis on the 15 emotion items. Loadings less than .4 were omitted.*

The factor analysis resulted in four factors with eigenvalues over 1. Factor 1 was labelled: anger/disappointment. Items measuring anger and sadness loaded on this factor. Factor 2 was labelled surprise, factor 3 was labelled anxiety and factor 4 was labelled happiness. Together, these factors explained 71% of the variance. Respondents’ factor scores on each of the
factors were saved as new variables. For each factor, a group of low scorers and high scorers was selected; respondents scoring below the 25th percentile were considered scoring low on the factor, respondents scoring over the 75th percentile were considered scoring high on the factor.

Of the 12 video fragments, 8 were related to following distance, 3 showed overtaking on the inside and one showed running the amber light. Reliability analyses showed that the close following and overtaking fragments together formed reliable scales, whereas the one fragment regarding running the amber light reduced reliability. It was decided to omit this last fragment from the analyses. Four questions were asked after each fragment, measuring risk perception, optimism bias, illusion of control and behaviour intention. The scores on the 11 fragments were summed up for each variable, resulting in 4 sum scores. For risk perception, optimism bias, illusion of control and behaviour intention, low scores meant respectively 'not safe', 'more likely to have an accident than the average driver', 'little control' and 'not likely to drive like that'. Only the posttest was considered since this was in time the closest to the measurement of the emotions, which were measured only in the posttest.

To investigate whether the sum scores of risk perception, optimism bias, illusion of control and behaviour intention differed for persons scoring high and low on the emotion factors, univariate analyses of variance were carried out. The four emotion factors (high versus low) served as independent variables and the sum scores for risk perception, optimism bias, illusion of control and behaviour intention as dependent variables. Age was included as a covariate, but only for analyses including risk perception and illusion of control since correlation analyses showed that age was related to these dependent variables. None of the effects were significant.

4.2.3. Discussion

The aim of the present study was to compare cognitive processes of persons in positive, negative and neutral emotional state. This turned out to be problematic because the emotion manipulation was unsuccessful. The video fragments were evaluated in a more cautious way in the posttest compared to the pretest. This difference was, as expected because of the unsuccessful emotion manipulation, not affected by experimental condition. The emotion manipulation procedure was chosen because of three reasons. First, the basic idea of the manipulation was false feedback, which showed to be effective in several other studies (Levine and Burgess, 1997; Forgas, 1994; Hockey, Maule, Clough, & Bdzola, 2000). Second, theories in the area of emotion
(Frijda, 1986; Lazarus, 1991; Scherer, 2001) claim that an emotion can only occur if the event touches a personal concern or goal. Therefore the procedure was designed in a way that respondents actually thought they had gained or lost money, so a real concern was touched. Third, the simulator route included situations that are known to cause frustration in real traffic, which was expected to ensure a certain degree of face validity.

The question that remains is why the procedure did not elicit the emotions that it was supposed to. Several explanations are possible. First, it might be that the emotions did occur, but did not last long enough. After the emotion manipulation procedure, the respondents had to watch the whole series of video fragments and answer the accompanying questions. This took about 20 minutes, after which the manipulation check took place. It is possible that after 20 minutes the emotion had already faded.

Second, it is possible that the respondents of the study formed a specific and highly motivated group, who enjoyed participating in the study and were therefore not sensitive for the financial reward. Some evidence for this can be found in comments of the respondents after they heard they had lost money: "well, it wasn’t for the money that I participated anyway". Third, respondents may have been suspicious: some respondents mentioned afterwards that they did not believe they would actually receive less money because of bad performance. A post-task questionnaire might have clarified the thoughts of the respondents in a more systematic way.

The additional analyses did not reveal any significant results. This is presumably due to the fact that there were not many respondents with a sufficiently high score on the negative emotions. For example, even the 25% of the respondents with the highest scores on the factor anger / disappointment had mean scores of only 1.8 for reported anger and 1.7 for reported annoyance. Likewise, the happiness scores were high for all respondents. In sum, from the study it can be concluded that because of the unsuccessful emotion manipulation, no causal relations could be shown between emotion and cognitive processes.

4.3. Study 2

Because of the failing manipulation in Study 1, no comparisons could be made between the groups and the hypotheses could not be tested. Therefore, it was decided to carry out a second study with basically the same design, but with a different emotion manipulation procedure, that did not involve the driving simulator. Also, a measure of Sensation Seeking, instead of trait
anger and trait anxiety, was included in the experiment. Sensation Seeking (Zuckerman, 1994) is a personality scale that aims to measure the tendency of people to engage in exciting or thrilling activities. It consists of 40 forced-choice items which require a choice between an exciting activity and a more cautious alternative. Within the Sensation Seeking Scale, four subscales can be distinguished: Thrill and Adventure Seeking, Experience Seeking, Boredom Susceptibility and Disinhibition. It was hypothesised that the emotion manipulation procedure would be most effective in people who score high on Sensation Seeking. Another reason to include Sensation Seeking in the experiment, is that relations have been shown between Sensation Seeking and risk taking behaviour (Horvath & Zuckerman, 1993; Heino, 1996; Jonah et al., 2001).

4.3.1. Method

The study had in general the same design as Study 1: a pretest-posttest design with a control group. Also the dependent measures were the same. However, the studies differed in several aspects. First, in Study 2 there was only one experimental (negative emotions) group and one control group. Second, the emotion induction procedure was different and emotional state was measured before and after the emotion induction. Third, Sensation Seeking was included as a personality measure. Fourth, whereas in Study 1 respondents were tested individually, in Study 2 respondents were tested in groups of approximately eight persons. This made it possible to include more respondents in the study, which was necessary to be able to distinguish groups of high and low sensation seekers. And finally, a post-task questionnaire was included in Study 2. In Table 4.3 the design of Study 2 is shown.

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<th>Time = 1</th>
<th>Time = 2</th>
<th>Time = 3</th>
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<tbody>
<tr>
<td>Negative emotion group (n = 75)</td>
<td>Pretest</td>
<td>Emotion induction</td>
<td>Posttest</td>
</tr>
<tr>
<td>Control group (n = 82)</td>
<td>Pretest</td>
<td>Short break</td>
<td>Posttest</td>
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</table>

Table 4.3. Design of study 2.
Respondents
Respondents were 157 car drivers who were recruited by media advertisements in a local newspaper. They were told that during the experiment they would be asked to participate in a traffic quiz and to evaluate traffic scenarios showed on video. The sample included 70 males (44.6%) and 87 females. The mean age was 44.3 years. The average time that respondents held their driver license was 22.5 years. The percentage respondents that drove less than 5,000 km in 2002 was 35.7%, 21.0% drove 5,000-10,000 km; 18.5% drove 10,000-15,000 km; 10.8% drove 15,000-20,000 and 14.0% drove more than 20,000 km in 2001. The sample differed slightly from the sample in the first study regarding average age and driving experience. This was mainly caused by the fact that the first study also included students; the second sample did not.

Pretest and posttest
The pretest and the posttest were identical with regard to all variables (background questions, Sensation Seeking scale, video fragments, emotion scale and general optimism bias and illusion of control). This was necessary because of the emotion manipulation, which will be discussed in the next section. Questions were asked regarding general background information (age, gender, driving experience etc.). Sensation Seeking was measured using a 20-items version of Zuckerman's Sensation Seeking Scale in a Dutch translation. The same video material was used as in study 1. However, the fragments concerning overtaking on the inside and driving through amber lights were omitted. Instead, the series of fragments related to following distance was extended with four fragments, leading to a series of 12 video fragments with varying following distance. After each video fragment, questions regarding risk perception, optimism bias, illusion of control, and behaviour intention, were asked. These questions were the same as those used in study 1. After subjects had evaluated the video fragments, emotional state was measured by using a Dutch translation of Izard's Discrete Emotions Scale (1977) without the subscale of disgust.

Emotion induction and procedure
Respondents were tested in groups of 8. Each group of 8 persons was randomly assigned to either the experimental or the control group. The respondents in the experimental group were told that they would first watch a series of video fragments at the computer. After each fragment they were required to answer several questions about the fragment. They were also told that after watching the fragments, they were required to answer questions in a traffic quiz, testing their knowledge and understanding of traffic situations. This study, the respondents were told, was developed to see if reward
influences performance on a quiz. For this reason, it was told, they would receive 5 euro extra on top of the 10 euro they would receive anyway by participating in the experiment, but only if they would answer 20 out of 30 questions correctly. After explaining this procedure to the respondents, they were asked to proceed with the first part of the experiment: watching the video fragments and answering the accompanying questions. When all participants had watched all video fragments and had answered the questions, the experiment leader said that she would first, before starting the traffic quiz, have a quick look at the data to check if all data were recorded to the network correctly. She then informed respondents that data were not saved to the network, and asked if anyone of the respondents had pressed the escape key during the experiment. None of the respondents agreed to have done so. The experiment leader then said that since the first part of the experiment (the video fragments) was very important, the respondents would have to do the task for a second time. Because there was not enough time to do both parts, the second part (the traffic quiz, with which extra money could have been earned) was cancelled. The respondents then did the video task for the second time. In reality, the data from both sessions were recorded without any problems. The first time served as the pretest and the second time as a posttest. It was expected that the combination of having to do a rather boring task twice, the missed chance of earning 5 euro extra and the implicit blame that the experimenter put on the respondents (by asking if anyone had hit the escape key) would induce sufficiently high levels of negative emotions.

Respondents in the control group were told that the study was partly meant to study the reliability of the scales. Therefore they were told that they had to do the video fragment task twice. They were warned that it could be a bit boring task in the end, but they were free to have a short break between the first and second time, to get some coffee or tea. It was expected that the respondents would not experience any anger or annoyance, because they knew exactly how long the task would last and what would happen during the experiment.

Post-task questionnaire
Both the experimental and the control group filled out a post-task questionnaire. Respondents were asked whether they thought the experiment was fun to do or boring, rated on 5-point scales. Also, they were asked whether they had tried to replicate their answers during the second time they watched the video fragments (yes or no). Respondents in the experimental group answered some additional questions. They were asked whether they felt bad about having to do the boring task twice, about
missing the additional reward, and about being blamed by the experiment leader (all these questions were rated on a 5-point rating scale). Also, they were asked how they felt immediately after they heard that they had to do the task for a second time. Items were "annoyed", "angry" and "frustrated", rated on a 5-point scale.

4.3.2. Results

Manipulation check
Figure 4.1 shows the means of the 15 emotion items for experimental (a) and control (b) group. For the experimental group, for the emotions "annoyed", "angry" and "frustrated" the means in the post task questionnaire are displayed as well. These are the mean results of the question "how did you feel immediately after you found out you had to do the video test again?" From the figure it is clear that the differences between pretest and posttest are small; both in the experimental and in the control group.

![Figure 4.1. Means of emotions scores in pretest and posttest, for the experimental (a) and control (b) group.](image-url)
Only for "annoyed" results showed a group * measure * Sensation Seeking interaction ($F(1, 88) = 4.08; p < .05$). Respondents in the experimental group who scored high on Sensation Seeking were more annoyed in the posttest than in the pretest. There was no difference in annoyance between pretest and posttest for respondents in the experimental group who scored low on Sensation Seeking. Neither was there a difference in annoyance between pretest and posttest for respondents in the control group regardless of level of Sensation Seeking (see Figure 4.2).

![Pre- and posttest scores for annoyance, distinguished by experimental group and level of Sensation Seeking.](image)

From these data it can be concluded that the manipulation was somewhat effective, but the differences between pretest and posttest are small and only significant for annoyance. Even for annoyance the difference was only significant for the group of high sensation seekers. Also, the mean level of annoyance was in this group only 1.8 on a scale from 1 to 5. Therefore, again no differences on the dependent measures could be expected. To verify this, repeated measures analyses were carried out with group (experimental, control) as between respondents factor, measure (pretest, posttest) as within respondents factor and the four sum scores of the video ratings (risk perception, optimism bias, illusion of control and behaviour intention) as dependent variables. For all four dependent variables there were main effects of measure: these were all in the direction that the video fragments were considered less safe in the posttest than in the pretest. However, no interaction effects were found between group and measure, indicating that the difference between pretest and posttest was the same for respondents from both the experimental and the control group.
Additional analyses
Because comparisons of the experimental groups were not possible, several exploratory analyses were conducted. First, a factor analysis was carried out on the 15 emotion items which resulted in 5 factors with eigenvalues over 1. Factor 1 was labelled: anger/disappointment. Items measuring anger and sadness loaded on this factor. Factor 2 was labelled: surprise; factor 3 was labelled worry, factor 4 was labelled happiness and factor 5 was called fear/anxiety. Together, the 5 factors explained 74.5% of the variance. Respondents’ scores on each of the factors were saved as new variables. For each factor, a group of low scorers and high scorers was selected; respondents scoring below the 25th percentile were considered scoring low on the factor, respondents scoring over the 75th percentile were considered. Then, analyses of variance were carried out using the new variables of high versus low factor scores as independent variables and the sum scores of risk perception, optimism bias, illusion of control and behaviour intention as dependent variables. No significant effects were revealed.

Second, respondents were divided in two groups, regardless of initial experimental group. Respondents who had actually turned more angry in the posttest than in the pretest were compared with respondents who had not turned more angry in the posttest than in the pretest. To this end, sum scores of the items "angry", "annoyed", "frustrated" were calculated for pre- and posttest. Next, respondents whose score in the posttest was at least two points higher than in the pretest were considered "angry", all others were considered "not angry". With regard to risk perception, angry respondents showed no difference on pretest (M = 39.2) and posttest (M = 39.1) whereas not angry respondents considered the video fragments as less safe in the posttest (M = 38.5) than in the pretest (M = 42.2); this difference approached significance (F (1, 153) = 3.7; p = 0.056). Angry respondents felt they had more control in the posttest (M = 47.5) than in the pretest (M = 45.8), whereas respondents who were not angry felt they had less control in the posttest (M = 44.1) than in the pretest (M = 46.6; F (1, 153) = 4.3; p < .05). Finally, angry respondents did not differ much in behaviour intention in the pretest M = 35.8) and posttest (M = 36.2) whereas respondents who were not angry had a lower score on behaviour intention in the posttest (M = 36.6) than in the pretest (M = 39.9; F(1, 153) = 4.1; p < .05). These results are presented in Figure 4.3.
The results consistently show differences between angry and not angry respondents in the difference between pretest and posttest. Still, the quasi-experimental design of these analyses leaves space for alternative explanations. There were differences between the angry and not angry respondents on the dependent measures already in the pretest, which might imply that a third variable influenced the results. To investigate this, the "angry" and "non angry" group were compared on several variables. Angry respondents had less driving experience (M = 16.1 years) than non-angry respondents (M = 23.4 years; F(1, 155 = 4.2; p < .05). Angry respondents also had a higher score on sensation seeking (M = 60.8) than non-angry respondents (M = 54.4; F(1, 155) = 5.0; p < .05). Angry and non-angry respondents did not differ significantly on age, gender, and kilometrage.

**Post-task questionnaire**

The analyses of the post-task questionnaires showed that most people thought the experiment fun to do (79.0%). Only 21.7% thought the experiment was boring. About one third (31.2%) of the respondents felt negative about having to do the same task twice. Only few respondents (8.0%) felt negative because someone presumably hit the escape key. The fact that there was no time left for the traffic quiz caused negative feelings in 73.3% of the respondents. A smaller percentage of respondents (40%) felt negative about missing the additional reward. Almost half of the respondent (45.9%) had tried to replicate their answers the second time. However, this
did not result in different scores: the video fragments were evaluated more risky in the posttest than in the pretest and this was the same for respondents who had and had not tried to replicate their answers. Finally, respondents were asked how angry, annoyed and frustrated they felt immediately after they heard they had to do the task for a second time. On a five-point scale, scores were 1.5 for angry, 1.9 for annoyed and 1.5 for frustrated.

4.3.3. Discussion

The research question of this study, similar to Study 1, was whether emotion leads to cognitive bias when evaluating traffic situations. Study 2 differed from study 1 in the sense that a different emotion manipulation procedure was used and a different personality measure was included. The results show that the emotion manipulation was again not sufficiently successful. Although some effects of the manipulation were shown for respondents scoring high on sensation seeking, still the mean differences were rather small. As expected, no effects of emotion manipulation on cognitive biases were found.

The question thus remains why the emotion manipulation procedure was again not successful. Three aspects were central in the procedure. First, respondents had to do a task twice; a task that was thought to be rather boring. Results from the post-task analyses showed, however, that most of the respondents did not find the task very boring, instead, most people considered the experiment fun to do. The second aspect was that respondents were implicitly blamed by the experimenter. Only a few respondents indicated that they felt bad about this. The third aspect was that respondents were led to believe they could win extra money in a traffic quiz: a possibility that was denied to them later on by the experimenter. About 40% felt bad about not being able to earn the extra money, and almost 75% felt bad about not being able to participate in the traffic knowledge test. Apparently participants liked to participate in the experiment and most participants were only disappointed about the cancelled quiz. They were not so much affected by the financial reward. They just followed the instructions of the experimenter, and when it turned out the experiment developed a bit different than planned, they easily accepted this change.

The post-task analyses also showed that although the effect of the emotion manipulation procedure was limited, it was stronger immediately after the emotion induction than later, when they performed the manipulation check. This suggests that if emotions would have been present, they had probably faded away at the time when emotions were actually measured. If this has
been the case and emotions have lasted only a few minutes, then they could not have affected the dependent measures because it took about 20 min to evaluate the video fragments.

Results from the exploratory analyses showed, first, that the evaluation of the traffic situations was different in the posttest than in the pretest. This measurement effect was present for all four dependent variables (risk perception, optimism bias, illusion of control and behaviour intention) for both experimental and control group. The rating of the video fragments was consistently more cautious in the posttest than in the pretest: respondents evaluated the fragments as less safe and less controllable in the posttest than in the pretest. They were less prone to optimism bias regarding their chances to be involved in a (near)accident in the posttest than in the pretest. And finally, they rated the probability to perform the same behaviour as the driver on the video, as less likely in the posttest than in the pretest. An explanation for this general measurement effect could be that respondents, after evaluating the fragments for the second time, knew the range of following distances appearing in the video fragments. The first series of fragments may have served as an anchor on which the second series of fragments were evaluated. Therefore, respondents might have been better capable of making accurate judgements. Inspection of the standard deviations of the video evaluations supports this hypothesis: for the majority of video fragments, the standard deviation was smaller in the posttest than in the pretest.

A second result from the exploratory analyses was that this general measurement effect did not occur for those respondents who had become angry during the experiment. These respondents gave similar ratings of the video fragments in the posttest and pretest. This could mean that the angry state prevented these respondents from adjusting their evaluation in a more risk-averse direction. It could also mean that respondents who become angry during an experiment are a different type of persons than respondents who do not become angry. The fact that there were differences between angry and non-angry respondents already in the pretest supports this. Also, the scores on sensation seeking of the two groups differed.

In summary, this study showed that although causal links between anger and cognitive bias could not be made, there does seem to be a relation between affective state and judgement. The question remains to which extent this is due to actual state anger or an underlying personality characteristic.
4.4. General discussion

The general aim of the two studies was to investigate the effect of specific emotions on cognitive bias in traffic. Both studies used a series of video fragments, although the collection of the fragments was slightly different. Study 1 used video fragments of both following distance and overtaking on the inside. Study 2 used only following distance. The video fragments formed reliable scales for each of the four dependent variables: risk perception, optimism bias, illusion of control and behaviour intention.

The results from study 2 offer some support for the hypothesis that anger is associated with cognitive bias. In both study 1 and study 2, the video fragments were evaluated more cautiously in the posttest than in the pretest. Study 2, however, showed that this was not the case for angry respondents: they did not adjust their evaluation in a more risk-averse direction. However, since the experimental design could not be maintained, results should be interpreted with caution.

This study has several implications which can be divided in methodological implications related to emotion induction, and implications for traffic safety. In the studies reported here, emotion manipulation turned out to be rather problematic. Some potential reasons have already been mentioned. The respondents probably formed a highly motivated group for whom the financial reward was not very important. Also, the laboratory environment might have been a rather unrealistic environment, in a way that all events were interpreted as being part of the experiment instead of a threat to real, personal goals. Still, the question remains why these manipulations were not sufficiently effective, whereas many other studies that used less intrusive methods, showed larger effects. Experimental methods that were earlier shown to be most effective are: “Imagination”, “Film/story”, “Experimental manipulation” and “Velten” (Gerrards-Hesse, Spies, & Hesse, 1994).

In the “imagination” methods, participants are asked to think about a positive or negative event. This can be something that has actually happened to the respondent in the past, but it can also be an imaginary event. Sedikides (1992) induced happy and sad moods using a guided imagery task. Subjects in happy mood were asked to imagine for 2 minutes that they had won a free cruise in the Caribbean. They were given brochures with pictures of cruises to help the imagination, and they were given 3 minutes to write about the event. Subjects in the sad condition were asked to imagine for 2 minutes that they were burnt in a fire and seriously disfigured. They were given
photographs of burnt victims and were given 3 minutes to write about it. Manipulation checks showed that the procedure was effective.

A method that is used in many studies on emotion is the use of video fragments (Hirt, Levine, McDonald, Melton, & Martin, 1997; Asuncion & Lam, 1995; Rosselli, Skelly, & Mackie, 1995). Respondents are asked to watch video fragments from comedies (positive mood) or from sad films (negative mood). This method proved to be effective in these studies, although no distinction was made between specific emotions. It is especially difficult to compare anger and fear by using video fragments (Gerards-Hesse et al., 1994).

Another method that is often used is experimental manipulation. Levine and Burgess (1997) studied the effects of specific emotions (happiness, anger and sadness) on memory. Happiness and negative emotions were induced in undergraduate students by randomly assigning a low (D) or high (A) grade on a surprise test. Manipulation checks showed that subjects receiving an A were more happy than subjects receiving a D. Subjects receiving a D were more sad and more angry than subjects receiving an A.

In the Velten procedure, subjects are presented with a series of self-referent statements, visually (written on cards) and orally (played from an audio tape). Subjects are asked to read or listen to the statement carefully and try to experience the mood suggested by the statements. Statements vary from relatively neutral (“Today is no different from any other day”) to elation (“I really do feel good”) or depression (“Every now and then I feel so tired and gloomy that I’d rather just sit than do anything”). Several studies showed that the Velten procedure was effective to induce positive and negative mood (Bartolic, Basso, Schefft, Glauser, & Titanic, 1999; Armitage, Conner, & Norman, 1999; Sinclair & Mark, 1995, study 1).

The methods described above are often used in emotion research and are reported to be effective. In most cases, effects of the emotion manipulation on cognitive processes are reported, such as memory, social judgement and risk perception. However, the above discussion shows that they are often unclear about the exact procedure and design of the emotion manipulation. In most studies no control group is reported and no indication is given about either intensity or duration of the effect. In our study, a classical experimental pretest-posttest design with one or two experimental groups and a control group was used and still the effects were either absent or rather weak. Therefore, the question remains whether the reported effects of other studies can be attributed to the emotion manipulation procedure, or whether
alternative explanations are possible, such as personality differences between groups.

Despite the unsuccessful emotion manipulation, the studies reported here provided some support for the hypothesis that emotion is related to cognitive bias in traffic. In the introduction it was stated that the area of emotions in traffic research is dominated by the anger-aggression relationship. The present study shows that emotions may have more diverse effects on driving-related performance. This is all the more relevant, because one of the reasons that young drivers are over represented in accident statistics, is their combination of overestimating their driving skills and underestimating the complexity of the traffic situation (Kuiken and Twisk, 2001). If emotions increase this bias in judgement, more research is needed about the prevalence of such emotions and the ways to cope with them. Furthermore, as the present study was carried out in the laboratory, future research should thus focus on the comparison between emotions elicited in controlled laboratory situations and emotions elicited in a naturalistic environment.