Transportation Research Part F 23 (2014) 125–132

Contents lists available at ScienceDirect

Transportation Research Part F

journal homepage: www.elsevier.com/locate/trf

When emotions disturb the localization of road elements: Effects of anger and sadness

Christophe Jallais *, Catherine Gabaude, Laurence Paire-ficout

Université de Lyon, F-69622 Lyon, France
IFSTTAR (French Institute of Science and Technology for Transport, Development and Networks), TS2-LESCOT (Laboratory of Ergonomic and Cognitive Sciences for Transports), 25 Avenue François Mitterrand, F-69675 Bron, France

ARTICLE INFO

Article history:
Received 30 April 2013
Received in revised form 26 September 2013
Accepted 12 December 2013

Keywords:
Mood
Anger
Sadness
Perception
Driving
Attention

ABSTRACT

While driving the activation of particular schemata induces an attentional focus where road users and road elements can be expected. Moreover, negative emotions can interfere with the information processing and the management of attentional resources leading to inattention.

We compared two negative emotions according to the arousal dimension (exciting versus calming) rather than according to the hedonic value. Three mood states (anger, sadness and neutral) have been induced to reveal their effects on the localization of road elements. We used a modified version of the jumble scenes paradigm to provide evidence for the existence of driving-related schemata which appeared to be guiding visual search. The results reported here revealed that the three groups take more or less advantage of the use of their visual schemata to localize road elements. Sadness increased the localization error rate. Participants induced in anger, were slower to locate road elements than participants induced in sadness and in neutral mood. These results are congruent with the fact that drivers exposed to anger-could be slower to detect atypical hazards. Future studies should go deeper in the understanding of how emotional states regulate attentional capacities.

1. Introduction

Driving requires many perceptual and cognitive processes as perception and attention. While driving but also in daily activities, drivers have to select relevant information and inhibit distractors. Driving at an intersection is a complex and fast-paced task at once (Hakamies-Blomqvist, 1996). This situation engages many perceptual and cognitive processes that can be affected by many factors such as ageing (Lengenfelder, Schultheis, Al-Shihabi, Mourant, & Deluca, 2002; Owsley, 2004) or emotions (Lemercier & Cellier, 2008). Negotiating an intersection involves both focusing of attention as well as efficient switching of attention between the relevant sources of information.

One of the most debated issues in the study of visual search is to determine if visual stimuli can capture attention automatically, independently of the observer's goal, beliefs or intention (e.g., Theeuwes, 2004; Theeuwes & Godijn, 2001). Theeuwes (1996) and Theeuwes and Hagenzieker (1993) had demonstrated the importance of top-down processes in the perception of traffic scenes. They showed that participants started their visual search strategically, only at locations which

* Corresponding author at: IFSTTAR (French Institute of Science and Technology for Transport, Development and Networks), TS2-LESCOT (Laboratory of Ergonomic and Cognitive Sciences for Transports), 25 Avenue François Mitterrand, F-69675 Bron, France. Tel.: +33 (0)4 72 14 24 44; fax: +33 (0)4 72 37 68 37.

E-mail address: christophe.jallais@ifsttar.fr (C. Jallais).

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http://dx.doi.org/10.1016/j.trf.2013.12.023

are likely to contain an expected element (i.e., traffic sign, other road users). The nature of contextual effects on the processing of objects in a scene is thought to be the result of an interaction between incoming perceptual information (bottom-up processing) and higher level memory representations (top-down processing) known as frames (Minsky, 1975) or schema (Bartlett, 1932; McClelland & Rumelhart, 1981). These schemata are a prototypical representation of traffic environments which contains informations regarding the typical spatial relationship between the road elements and road users (Theeuwes & Godthelp, 1995). The type of road (e.g., an intersection) activates particular schemata which let driver expect the location of road users and road elements.

One of the underlying hypotheses is that an object represented in the schema will be encoded automatically or rapidly, and will require less processing resources than an object that does not fit in. But the controlled use of schemas requires conscious effort and working memory resources (Kalyuga, Ayres, Chandler, & Sweller, 2003). To be operated under automatic rather than controlled processes, schemas have to be sufficiently practiced (Schneider & Shiffrin, 1977). Thus driving experience can help drivers in their visual search. Indeed, Chapman, King, and Underwood (2002) showed that experienced drivers have wider scanning strategies than novices and shorter fixation durations in hazardous situations. The differences in the visual search observed were according to the authors, due to the use of relevant driving-related knowledge in their visual search. In this study, participants had to search for objects in static driving scenes which were presented either as standard views from the driver's perspective or as randomly jumbled (or rearranged) scenes. They divided the intersection scenes in nine sections and presented these scenes in three ways. The pictures could either be presented in their original coherent form, or could be rearranged (jumbled). In one jumbled condition all the sections were rearranged (Fully condition) and in another condition, all sections, except the area where the target (for example, traffic light) is located are jumbled (Partly condition). The authors supposed that the differences between localization times in original and rearranged scenes were a measure of the use of driving schemata. The context of the road scene is involved by the relationship existing between various elements in the scene. Chapman et al. (2002) showed that drivers were more aware of the typical distribution of information in actual scenes than non-drivers. Moreover, the search times observed revealed that participants might have a tendency to perform a visual search on the most usual location in which the target might appear. These results revealed an effect of driving experience on visual search and that the context may help to localize objects (Chapman et al., 2002; Giraudet & Azavant, 2006). This paradigm using rearranged versus original scenes can offer a new way in the study of the impact of mood on the localization of different objects in the driving environment.

Previous studies showed that mood or emotions can affect the use of general knowledge, such as scripts or schemata (Bless, 2001; Bless, Fiedler, & Forgas, 2006; Jallais & Corson, 2008). According to the traditional valence-based definition of mood, on one side positive moods lead to increased optimism and tendencies to engage heuristic style processing. On the other side, negative moods, as sadness, lead subjects toward an analytic processing style which gives priority to a detailed analysis of the information (Fiedler, 1988; Schwarz, 1990). From this point of view the effects of a negative mood are more considerable if the task constraints lead to a kind of processing similar to that promoted by the induced mood.

In the same way, it is supposed that subjects in negative mood leave their minds wandering, rather than focusing their attention on the task in hand. Ellis and Moore (1999) supposed that negative moods can lead subjects to develop irrelevant thoughts and therefore decrease attentional resources. They supposed that the emotional states regulate attentional capacity. The lower capacity of the attentional resources are due to the fact that some attentional resources that would normally be used to perform the task are impacted by irrelevant thought in depression or negative mood such as sadness. The authors considered two possibilities: in the first case, the depression or the negative mood induction produces no deficit. This can be due to the fact that sufficient attentional resources are available to perform the task demanded, or because the task itself requires not enough attentional capacity or because the induction or depression are low. In contrast, in the second case, if the task requires significant attentional resources or if depression or the mood induction is intense, then subjects' performance could be impacted. In addition to the intensity of emotional states and the complexity of the task, the authors assumed that the capacity in the allocation of attentional resources are dependent on many factors such as personality, age, or level of expertise. Several studies have confirmed this assumption of limited capacity. Thus, both depression and anxiety seem to be associated with a reduced ability to perform complex cognitive tasks (Eysenck & Calvo, 1992, 1998; Mueller, 1992). One confirmation of the relevance of this model comes from the study developed by Ellis, Varner, Becker, and Ottaway (1995) which showed a lesser use of general knowledge because of the negative mood (sadness).

However, the valence-based approaches can be criticized. Besides the distinction between positive and negative mood valence, some other distinctions exist between different mood states of the same valence. For instance, some studies have already shown that two negative mood states, i.e. anger and sadness, have distinct effects on information processing (Gilet & Jallais, 2011; Storbeck & Clore, 2008). So, anger induction leading participants to process information on an automatic mode just like participants induced in a positive mood whereas sadness favors analytic processing of information (e.g., Bodenhausen, Sheppard, & Kramer, 1994). These results suggest that valence (the hedonic value) is not the only dimension of mood and that another one may be associated with variations in cognitive processing: arousal. Whereas valence usually refers to the hedonic value of a mood state, arousal is defined either as the intensity of an event ranging from very calming, relaxing to highly exciting (e.g., Kensinger & Schacter, 2006; Russell, 1980), the perception of arousal associated with an emotional experience (e.g., Feldman, 1995) or as a level of vigilance or activation (e.g., Revelle & Loftus, 1992).

In the same way, negative mood (sadness) is thought to promote the use of a detail-oriented processing of information (Bless et al., 1996). Moreover, studies, about the effect of sadness on driving, showed that this mood state increases irrelevant thoughts, and decreases the attentional resources leading to inattention (Lemercier & Cellier, 2008; Pêcher, Lemercier, &