Behaviors and Causal Explanations of Road-Tunnel Users During a Fire*

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Abstract

The present study was aimed at describing the behaviors of tunnel users in the event of a road-tunnel fire, and to determine the effect of stress on these behaviors. Another aim was to identify the causal explanations offered by tunnel users for fires and for non-evacuation behaviors after a fire alarm is given. Several fire scenarios were presented to 217 participants, who were asked to predict their likely behavior in the situations described, and to give explanations for the fire's occurrence. The participants' perceived stress level was also measured using a subscale taken from the Depression Anxiety Stress Scales (DASS; Lovibond, & Lovibond, 1995). The results showed that the participants tended to adopt more risky behaviors in situations where traffic was moving freely than in congested traffic. The users' perceived stress led them to adopt unsafe behaviors, but contrary to Hennessy and Wiesenthal's (1997) results, this relationship was stronger in free-flowing traffic than in a traffic jam. Some of the participants demonstrated a certain behavioral rigidity, tending to adopt identical behaviors regardless of the traffic situation. The behaviors stated for a given situation seem to be consistent, but they were not always safety-conscious. And the more serious the fire, the more internal the explanations were. Finally, non-evacuation behaviors were attributed mainly to internal factors that implicated the concerned individuals. Some suggestions for long-term preventive actions based on users' beliefs and representations are proposed.

Keywords: accident causes, tunnel fires, risk perception, causal attribution, evacuation behaviour

Résumé

La présente étude vise à appréhender le comportement des usagers à l'occasion d'un incendie dans un tunnel routier et de cerner l'effet du stress sur ce comportement ainsi que les explications causales fournies pour les incendies de tunnel et les comportements de non-évacuation lorsqu'une alerte est donnée. Différents scénarios d'incendie sont proposés à 217 participants qui doivent évaluer leur comportement probable dans les situations décrites ou fournir des explications pour l'incendie qui y est décrit. On mesure également le niveau du stress perçu des participants à l'aide d'une sous-échelle extraite de l'Echelle de Dépression, Anxiété et Stress (DASS, Lovibond, & Lovibond, 1995). Les résultats montrent que les participants tendent à adopter des comportements plus risqués en situation de trafic fluide qu'en situation de trafic intense. Le stress perçu des usagers les conduit à adopter des comportements inadaptés, mais contrairement à Hennessy et Wiesenthal (1997), la relation est plus forte en situation de trafic fluide qu'en situation de trafic avec congestion. On notre une certaine rigidité comportementale de certains participants qui tendent à adopter des comportements identiques quelle que soit la situation du trafic. Les comportements déclarés semblent cohérents à l'intérieur d'une même situation mais pas toujours sécuritaires. Les explications fournies pour les incendies sont d'autant plus internes que les incendies sont graves. Enfin, les comportements de non-évacuation sont attribués majoritairement à des facteurs internes propres aux personnes impliquées. Des suggestions pour des actions de prévention durables fondées sur les croyances et les représentations sont proposées.

Mots-clés : causes, accident**,** incendies de tunnel, perception des risques, attribution causale, comportement d'évacuation

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Rezumat

Această cercetare își propune să descrie comportamentele oamenilor în situații de incendiu într-un tunel rutier și să determine efectele stresului asupra acestor comportamente. Un alt scop a fost identificarea explicațiilor date de participanți pentru incendiu și pentru comportamente împotriva evacuării după pornirea alarmei de incendiu. Mai multe scenarii de incendiu au fost prezentate unui număr de 217 participanți, cărora li s-a cerut să-și estimeze comportamentul probabil în situațiile descrise și să dea o explicație pentru apariția focului. Nivelul de stres perceput de participanți a fost măsurat folosind o sub-scală din Depression Anxiety Stress Scales (DASS; Lovibond, & Lovibond, 1995). Rezultatele arată că participanții tind să adopte comportamente mai riscante în situații în care traficul era lejer decât în situații de congestie a traficului. Nivelul perceput al stresului îi conduce să adopte comportamente riscante, dar contrar rezultatelor obținute de Hennessy și Wiesenthal (1997) această relație este mai puternică în situații de trafic normal decât în situații de trafic blocat. Unii participanți au arătat o oarecare rigiditate comportamentală, tinzând să adopte aceleași comportamente indiferent de situația din trafic. Comportamentele estimate pentru o anumită situație au fost consistente, dar nu au fost întotdeauna conștient-sigure. Cu cât focul este mai mare cu atât subiecții au dat mai multe explicații. Comportamentele non-evacuare au fost atribuite în principal unor factori interni, care au vizat indivizii. Articolul propune câteva sugestii pentru acțiuni preventive pe termen lung bazate pe reprezentările și credințele utilizatorilor.

Cuvinte-cheie: cauze ale accidentelor, incendii în tunel, percepţia riscurilor, atribuire cauzală, comportament de evacuare.

Preventing accidents hazards to which workers are daily confronted, is nowadays a big concern in the management of organisations, whether accidents at work or commuting or occupational diseases. Health and Safety of workers is an important condition for their investment in work and their effectiveness. Tunnel users are most often workers who go to work or where going from work to home. According to safety regulations, commuting accident (i.e. the accident that occurred to a worker during round trips between his home and the workplace) is also considered as an occupational accident, since the path was not interrupted or diverted for reasons dictated by personal interest or a motive not related to the necessities of everyday life or to work. It should also be noted the case of a great number of workers whose job is to drive all day long (professional drivers of trucks, buses, taxis, etc.) and are therefore exposed to fires and accidents in tunnel. So, the management of accidents and tunnel fires appears as a matter which also concerns the management of health and safety of workers, i.e. human resource management. This article seeks at describing the behaviors and causal explanations of road-tunnel users during a fire.

Identifying the causes of accidents is a fundamental step in implementing prevention strategies. This step precedes and determines the conditions for preventive actions. Following attribution theory (Heider, 1958; Kelley, 1971), people need to be in control of their environment. „In order to keep some feeling of control over their environment, and also no doubt for other reasons (such as avoiding being held responsible), members of an organization engage more or less actively in the search for the causes of accidents, those unforeseeable and troubling events. Some studies have nevertheless shown that explanations of an accident or negative event within an organization vary with a number of factors, including the social role of the persons involved in the accident, their social status, and their hierarchical position within the organization (Mitchell & Wood, 1980; Kouabenan, 1985a, 1985b, 1990, 1996, 1998, 1999; Hamilton, 1986; Dejoy, 1987; 1994; Lacroix & Dejoy, 1989; Salminen, 1992; Niskanen, 1994)" (Kouabenan, & al. 2001, pp.553-554). Therefore they are motivated to understand the causes of the events which happen to them or happen in their environment. According to attribution theory, they generally search for the locus of the causes which could be either internal to them or external to the stimuli persons involved in the accident (i.e. linked to the environment or situational). Following this theoretical background, we have shown in previous studies that the process of explaining accidents can be spontaneous and implicit, and may implicate ordinary, non-specialist individuals as well as safety experts (Kouabenan, 1999; Kouabenan, 2009). We have also shown that, whether given by experts or laypeople, accident accounts vary across situations (seriousness of the accident, its relevance, etc.) and according to the characteristics of the victims and the people doing the explaining (level of involvement, social or hierarchical position, type of relationship, etc.). These variations induce explanation biases, which can be cognitive, motivational, or affective in nature (Kouabenan, 1999, 2000, 2006b; Shaver, 1970; Walster, 1966). Finally, we have demonstrated that the explanations people give – whether spontaneous or more systematically elicited — tend to influence not only their safety-related attitudes and behavior but also their knowledge (Kouabenan, 2000, 2006a, 2006b, and 2006c). For these reasons, insight into how road-tunnel users explain accidents and fires occurring in tunnels is very important for understanding their behavioral choices, and for planning effective prevention programs.

The present study concerns the behavior of users during accidental events observed in road tunnels, the relationships between those behaviors and perceived stress, and the causal explanations that tunnel users offer for these events. More specifically, we were interested in people's reported behaviors during road-tunnel fires, their causal attributions regarding fires, and their explanations of the non-evacuation behaviors observed in such situations. We also considered the situation's relevance, the seriousness of the accident, the perceived stress level, and the effect of the person's expertise level on the explanations given. Past studies examining the relevance factor (Shaver, 1970; Shaw & McMartin, 1977; Kouabenan, 1999; Kouabenan, Gilibert, Médina, & Bouzon, 2001) have shown that combining high situational relevance with low personal relevance typically produces internal causal attributions implicating the persons involved in the accident. One notable finding is that serious accidents tend to generate defensive explanations, especially when the situation is relevant for the people who are asked to explain it. This tendency derives from the observer-analyst's desire to rule out the possibility that such an accident could happen to him/her, and thus to implicitly avoid having to undergo its negative consequences.

We are also interested here in the behaviors observed during tunnel-fire evacuation situations, and the explanations provided by users for these behaviors. In such cases, it seems that people do not spontaneously evacuate the tunnel even when a warning has been given. In the Mont Blanc tunnel fire, some vehicles continued to drive into the tunnel in spite of the warning. For certain authors like Shields and Boyce (2004), people do not perceive themselves as being in immediate danger because the information available to them is ambiguous (e.g., they smell the smoke but do not hear any fire alarms, or they hear the alarms but at the same time see other drivers entering the tunnel, etc.). In short, they either ignore the relevant information (Boer, 2002) or interpret it as a „false alarm“. In tunnels, the ability to recognize warning signals and to react quickly are among the pre-evacuation activities that are played out in the self-rescue phase. In this phase, users must rapidly perceive the danger, understand the meaning of the signals (for example, smoke or flames), conceive a plan of action, execute the plan, and assess whether the actions undertaken match the optimal resolution of the plan. Some studies (Proulx, 1993) have suggested that the self-rescue phase engenders a high level of stress. It has also been shown that congested traffic triggers or accentuates the stress experienced by drivers (Hennessy & Wiesenthal, 1997). In the pre-evacuation phase, the rapidly and constantly changing situation must continually be redefined, in response to new information and feedback resulting from previous decisions (Lazarus & Folkman, 1984). The fact that the decision-making process must take place under conditions of ambiguous information, time pressure, and threats to survival (both of oneself and the group) is a factor that adds to stress. It therefore seems worthwhile to analyze how perceived stress during evacuation situations affects people's reported behaviors and the explanations they provide for non-evacuation behaviors when a fire starts up.

To sum up, the present study is directed to following main objectives: First it aims to examine if reported behaviors in fire situations vary according to the state of the traffic (a traffic-jam versus a free-flowing traffic). Because people tend to adjust their behavior to traffic conditions (See Wilde's theory of homeostasis, 1982), we expect tunnel users to adopt more careful self-rescue behaviors in a free-flowing traffic situation than in a traffic jam situation. We also check if the reported behaviors are consistent (see *hypothesis 1* in the results section). Second, we hypothesized that users thinking about evacuating the tunnel would choose different routes, depending on the traffic situation (*hypothesis 2*). Third, following Hennessy and Wiesenthal (1997), we state the more people feel stressed in a fire situation, the more they should adopt panicky behaviors (*hypothesis 3*). Fourth, according to previous studies (Walster, 1966; Shaver, 1970; Shaw & McMartin, 1977; Kouabenan et al., 2001) and the defensive attribution hypothesis, the present study examines also the effect of fires seriousness and the situational relevance* on causal attributions. According to the authors quoted above, accident severity and situational relevance are favourable conditions to elicit defensive attributions, i.e., people tend to exhibit defensive attributions when the accident is serious and when the situation in which it occurred is relevant for them (Shaver, 1970) (see *hypothesis 4*). Finally, the fifth objective of this study is to understand how ordinary people (non-specialists) explain the fact that in fire situations, people do not always evacuate the tunnel, even after they have received a warning or evacuation instructions (it seems to be the case in the Mont-Blanc tunnel fire). Because of the tendency to a self-protective bias (Shaver, 1970; Shaw & Mc Martin, 1977, Walster, 1966), we hypothesized that participants would make more internal than external attributions to explain non-evacuation behavior during road-tunnel fires, and that their explanations would be influenced by their gender, their course of study at the university, and whether or not they had received first-aid training (see *hypothesis 5*).

Method

Study Participants and Procedure

The sample for this study consisted of 215 students: 104 were psychology students and 87 were engineering students enrolled in the PRIHSE department (Prevention of Industrial Risks: Health, Safety, Environment) and 26 were students in a polytechnic school (physics, mathematics, mechanical engineering). The sample was 69.8% women and 30.2% men. The ages of the participants ranged from 18 to 44 years (M = 21.40, SD = 3.24). The questionnaires were administered collectively in lecture halls and classrooms located on the campus of the University of Grenoble II, France.

All of the students volunteered to participate. Before receiving the questionnaire, the participants were informed about the purpose of the study and the format of the questionnaire. They were randomly assigned to the different groups (n = 5) defined on the basis of situational relevance and fire seriousness, and then given the appropriate questionnaires.

Materials

The study was performed using a five-part questionnaire, each consisting of quasi-experiments based on scenarios. The first part (6 questions) presented two fire situations (free-flowing traffic *vs.* a traffic jam) and assessed the reported evacuation behaviors of participants in these two situations. Based on previous observations (Kouabenan, Caroly, & Gandit, 2005; Kouabenan, Gandit, & Caroly, 2006a & b), several possible behaviors were proposed to the participants: telephoning and waiting for rescue; evacuating the tunnel on foot; staying in the car and waiting until the cars in front start moving forward; trying to put out the fire; looking for a shelter area; honking the horn and waiting for others to move on. The participants were told to assess the likelihood of their adopting each of these behaviors on a 5-point Likert-type scale ranging from 1 (very unlikely) to 5 (very likely). Here is an example of the instructions: *„You are surprised by a fire in a single-tube road tunnel in which there is a traffic jam* (or *free-flowing*

* The situational relevance reflects the extent to which the person who makes causal attributions for the accident could find himself in the same situation in the future.

traffic). *For each of the different possible behaviors in this situation, assess the likelihood of your adopting it.“* In addition, an open-ended question allowed the participants to indicate, for each situation, any other behavior that they might adopt. A final question dealt with the route they would use to evacuate the tunnel.

The second part (4 questions) presented a tunnel fire situation in four different versions resulting from crossing two factors, the seriousness of the fire (serious *vs.* not serious) and the perceived situational relevance (high *vs.* low). This gave us four experimental groups and one control group. The control group was given a scenario with no cues as to seriousness or situational relevance. After reading the scenario assigned to his/her group, each participant had to explain the accident by giving a rating on a 5-point Likert-type scale ranging from 1 (very low probability) to 5 (very high probability) of the causal or exacerbating role of 14 probable causal factors of the fire, presented in random order (8 external factors and 6 internal factors). One question allowed participants to mention other factors besides those on the list that they thought might have played a role in causing the fire. Participants were also asked to evaluate the seriousness of the fire described, and the probability that they might find themselves in a similar situation (situational relevance).

Sample Scenario: Serious, Relevant Accident

One morning when the weather is good, a heavy truck that is hauling merchandise breaks down in a parking area situated about 5 kilometres before the exit of a tunnel (in the direction that the vehicle is going). Suddenly the truck catches fire. Without trying to put out the fire, which in a very short time is blazing, the inexperienced driver leaves the tunnel. Very quickly, the fire spreads to other vehicles.

Although the traffic lights located at the entrance of the tunnel are red, vehicles continue to drive into the tunnel.

The accident happens in France, on a highway heavily used by people living in France or visiting the country. The tunnel, which is just over 11 kilometres long, is a two-directional single-tube tunnel (one tube with two-way traffic) that has been in service for about 40 years. At the time the fire started, the traffic was moderately heavy. The tunnel is equipped with the usual safety devices, including video surveillance cameras and fire-alarm devices. The control centre's video camera is not working on one side of the tunnel (truck entrance side) and the detection system on the other side (exit side) was taken out of service the night before the incident because of several false alarms.

The intensity of the fire is such that the progress of rescuers is blocked by the thick smoke emitted within a few minutes by the burning vehicles. Successive teams of fire-fighters, impeded by the smoke, are forced to retreat to the pressurized shelters located near the parking areas for a period ranging from 5 to 7 hours. The fire-fighters were not equipped with breathing devices adapted to fires in tunnels.

It took two days to get the fire under control. The damage from the fire is considerable. As to property damage, 23 trucks and 12 automobiles were destroyed by the fire. The human toll was of unprecedented scope: 40 people perished in the blaze. Among these victims, more than 72% were found in their vehicles, which they obviously did not want to abandon. Two individuals who went into a shelter area were also found dead.

For the non-serious accident situation, the account was the same except that the consequences were given as follows: *It took 5 hours to get the fire under control. Very fortunately, the consequences of this fire are less serious than you might expect. The sum of the casualties was only 4 damaged vehicles and 3 injured people found in their personal vehicles* [...] *The period of time spent in the shelters was only 2 to 3 hours.*

In the third part of the questionnaire (2 questions), the participants were asked to assess the causes of non-evacuation behaviors observed during tunnel fires, by rating the importance of a series of possible causal factors on a 5-point Likert-type scale, containing two subscales, one for external explanations (16 factors) (e.g. insecurity of shelters, the obsolescence of the tunnel, $\alpha = .70$) and the other for internal explanations (12 factors)* (eg.: the recklessness of drivers who continue to enter the tunnel; the

* An internal factor is a factor that is in the control of the stimulus person involved in the accident and in external factor is a factor outside his control (something caused by the environment, the situation, the organisation, bad luck, etc.).

inexperience of the driver of the truck) (α=.67). Internal and external factors were mixed together in the scale. The fourth part consisted of a scale for measuring stress taken from the Depression Anxiety Stress Scales or DASS (Lovibond & Lovibond, 1995; Crawford & Henry, 2003). The scale consisted of 14 items and 4 response levels for each item, ranging from 0 (does not apply to me at all) to 3 (applies totally to me, or most of the time). The reliability index (α = 0.93) and the validity index of this subscale were very good (Nieuwenhuijsen et al*.,* 2003). The fifth and last part of the questionnaire was used to collect information on the demographic and sociological characteristics of the participants, as well as on their experience driving an automobile and using road tunnels.

The elaboration of the fire scenarios and associated responses was inspired by Kouabenan, Caroly, and Gandit's (2005) study; the explanation scales presented to participants were constructed according to the criteria utilized by Kouabenan *et al.* (2001).

Results

To compile descriptive statistics and test our hypotheses, the data were analysed using SPSS software (version 12.0).

Analysis of Reported Behaviors in Two Fire Situations: Free-Flowing Traffic vs. a Traffic Jam

Are People More Calm and Careful in Freely Moving Traffic than in Traffic Jam? (Hypothesis 1).

We hypothesized that the behaviors participants would report for a fire situation in a traffic jam would be different from those reported for a fire occurring in free-flowing traffic. In free-flowing traffic, because there is no obstacle, the likelihood of adopting a self-rescue behavior that follows safety standards should be lower. Indeed, following the theory of risk homeostasis (Wilde, 1982), improvement in traffic conditions does not necessarily lead to a better safety of the traffic ; on the contrary, drivers tend to drive more faster, maintaining in this way a constant level of risk.

Each item referring to a possible behavior represented one variable. There were six possible behaviors for each situation (free-flowing traffic *vs.* traffic jam). These variables were paired since it was the same subjects who assessed the probability of adopting one or the other of the six behaviors in each situation (measured on Likert-type scales).

Table 1. Means, Standard Deviations, and Comparison Tests of Behaviors Reported for Free-Flowing Traffic *versus* a Traffic Jam

	Traffic Jam		Free-Flowing Traffic				
	M	SD	M	SD	t	df	p
Honk horn at other cars to get them to move ahead	1.5161	0.93	1.85	1.23	-4.92	214	<.001
Stay in the car and wait for other cars to move ahead	1.73	1.11	2.48	1.25	-7.85	214	<.001
Try to put out the fire	1.90	1.02	1.83	0.98	1.55	213	.124
Telephone for help and wait to be rescued	2.64	1.21	2.32	1.12	4.38	214	<.001
Look for a shelter	3.67	1.19	3.02	1.37	8.55	215	<.001
Evacuate the tunnel on foot	4.05	1.10	2.58	1.25	15.93	211	<.001
Make a U-turn and evacuate the tunnel in the car	–		2.75	1.40			
Stop the car	–		1.93	1.06			

In order to verify Hypothesis 1 stated above, we compared the estimated probabilities reported for each behavior in the two situations, for all participants pooled, using a paired-sample t-test. To give one example, the probability of evacuating the tunnel on foot in a traffic jam situation was compared to the probability of evacuating the tunnel on foot in a free-flowing traffic situation. The normal distribution indexes were within the required limits. Table 1 presents the descriptive statistics and the comparative analysis of six behaviors for the two situations studied.

In the comparison of the reported behaviors in the two traffic situations (Table 1), the likelihoods of the behaviors differed significantly for all behaviors except trying to put out the fire, which was chosen by very few participants regardless of the traffic situation (t(213) = 1.54, *ns*). More specifically, people showed a significantly greater tendency to adopt certain behaviors in a traffic jam than in a free-flowing traffic situation: telephoning and waiting for rescue, $t(214) = 4.38$, $p < .001$, $d = 0.27$; evacuating the tunnel on foot, $t(211) = 15.93$, $p < .001$, $d = 1.25$; and looking for a shelter, $t(215) = 8.55$, $p < .001$, $d = 0.51$. By contrast, in the same situation (traffic jam), people were less likely to adopt the behaviors of staying in the car and waiting for others to move ahead, $t(214) = -7.85$, $p < .001$, $d = 0.63$, and honking the horn, $t(214) = -4.92$, $p < .001$, $d = 0.30$, than they would in freely moving traffic.

In line with our hypothesis, users tended to take more risks in free-flowing traffic than in a traffic jam. Looking at Table 1, we can see that the reported behaviors were ranked differently, depending on the situation. In a traffic-jam situation, users would first try to get out of the tunnel on foot ($M = 4.05$ and $M = 2.58$) (a behavior which is strongly advised, especially by way of emergency exits), then try to find a shelter ($M = 3.67$ and $M = 3.02$), and call and wait for help ($M = 2.64$ and $M = 2.31$). In free-flowing traffic, users would either be more passive (stay in their vehicle and wait until others move forward, $M = 2.48$ and $M =. 1.72$), more nervous (honk the horn for other vehicles to move ahead, $M = 1.85$ and $M =. 1.51$), or make unwise moves (do a U-turn and exit the tunnel in the car, $M = 2.74$). Passive waiting behaviors are not recommended, since a fire can spread very quickly and the shelters are not intended to protect tunnel users from flames and smoke for a very long period of time. Likewise, it is not at all advisable to try to make a U-turn with the car, since this entails a risk of collision with vehicles entering the tunnel and can impede the progress of rescue vehicles.

Were the Participants Consistent in the Behaviors They Reported? Overall, we noted a significant positive correlation between the reported behaviors in the two situations (Table 2). In other words, when a participant adopted a certain behavior in one situation, he/she tended to adopt the same behavior in the other. This result could reflect a certain behavioral consistency among participants, since they did not adapt their behavior to the situation or could be a measurement artefact as a propensity of the participants to orient their answers towards one end of the scale. The correlations ranged from .30 to .75.

Furthermore, we wanted to see if the behaviors were consistent within a given situation. For

Table 2. Relationships between the Behaviors Reported for the Two Situations (Traffic jam *vs* free-flowing traffic)

	N	r	*p*
Telephone for help and await rescue:	215	.57	<.001
Evacuate the tunnel on foot:	212	.37	<.001
Stay in the car:	215	.30	<.001
Try to put out the fire:	214	.75	<.001
Seek shelter:	216	.61	<.001
Honk horn:	215	.61	<.001

this, we examined the correlations between the behaviors reported in each situation. For the heavy-traffic situation (traffic jam), we looked for any significant positive relationships between behaviors. We found that the users who sought shelter were also those who would be ready to try to put out the fire (r = .21, p = .01) or to evacuate the tunnel on foot (r = .15, p = .05). Likewise, there was a significant positive correlation between the act of telephoning and waiting for rescue and the act of staying in one's car and waiting for others to go forward (r = .14, p =< .05). These two behaviors seem consistent and reflect a certain calmness and patience. Conversely, users who sought shelter did not try to telephone and wait for help (r = -.19, p = .01) or stay in their car (r = -.33, p = .01). Persons who preferred to stay in their car did not try to get out of the tunnel on foot (r = -.40, p = .01). Finally, a person trying to evacuate the tunnel on foot was not someone who would telephone for help and wait to be rescued (r = -.28, p = .01). With a few exceptions, then, the behaviors expressed in the heavy-traffic situation seem, on the whole, to be consistent.

In the free-flowing traffic situation, there was a significant positive correlation between certain behaviors, and a significant negative correlation between other behaviors. In this situation, when participants sought a shelter they also tried to evacuate the tunnel on foot (r = .30, p = .01) or stopped their car (r = .28, p = .01), but they did not stay in their car and wait for others to move forward (r = -.25, p = .01). Likewise, the users who would stop their vehicle were also those who would try to telephone and wait for rescue (r = .22, p = .01) or to evacuate the tunnel on foot (r = .22, p = .01). Those who would attempt to put out the fire would also try to telephone for help (r = .19, p = .01). These different behaviors appear to be consistent from a logical and safety standpoint. It is regrettable, however, that users who would try to evacuate the tunnel on foot would not try to telephone and wait for rescue (r = -.15, p = .05). Other participants — those who would honk their horn — were also those who would try to make a U-turn (r = .16, p = .05) or stay in their car (r = .18, p = .05), behaviors that are not very safety-conscious. Conversely, the more participants chose stopping their vehicle, the less they chose honking the horn (r = -.22, p = .01) or staying in their car (r = -.19, p = .01). Similarly, users who would decide to stay in their car were less likely to evacuate the tunnel on foot (r = -.30, p = .01), make a U-turn (r = -.21, p = .01), or stop their vehicle (r = -.19, p = .01).

Thus, for both traffic situations, we observed behaviors that were relatively consistent overall, although they were not necessarily safety-conscious in either case. For example, it is unfortunate that those who would try to get out of tunnel on foot would not take the time to notify rescue personnel first.

Evacuation Routes Taken in the Two Traffic Situations (Hypothesis 2)

We assumed that there would be a significant difference between the evacuation routes chosen during a traffic jam and those chosen when traffic is flowing freely. For example, one can assume that in a traffic jam, users will not hesitate to walk in the road, as compared to a free-flowing traffic situation in which they will be more likely to opt for emergency exits or sidewalks, both safety-conscious behaviors (*Hypothesis 2*).

The analysis was conducted for each of the two situations (free-flowing traffic *vs.* a traffic jam) on a nominal variable with three categories: in the road, emergency exit, and sidewalk. In order to test Hypothesis 2, we submitted the data to a chi-square test (χ^2).

Table 3. Evacuation Routes Chosen in Each Traffic Situation (Traffic Jam *vs* Free-Flowing Traffic)

	Traffic Jam	Free-Flowing Traffic	Total
In the road	15	21	36
Emergency exit	173	164	337
Sidewalk	28	28	56
Total	216	213	429

Table 3 presents the data observed in the two situations. The choice of evacuation route did not differ across traffic situations (χ^2 (2) = 1.22, *ns*). In both free-flowing traffic and traffic jams, when participants wanted to evacuate the tunnel on foot, a majority chose the emergency exit for this purpose. Since this is the recommended behavior, it means that in both traffic situations, most users chose the safest evacuation route.

In a free-flowing traffic situation, the choice of evacuation route was not found to differ significantly according to gender, frequency of tunnel use, or whether the participant had or had not completed first-aid or fire-safety training. In the heavy-traffic situation, the route chosen also differed little by frequency of tunnel use and first-aid or fire-safety training; it did differ, though, across genders (χ^2(2) = 7.98, p = .05). The emergency exit was the evacuation route preferred by participants as a whole. In a heavy-traffic situation, however, the women were more likely to take this route (84%) than the men (70%).

Stress and Behaviors in the Two Traffic Situations (Hypothesis 3).

We hypothesized that there would be a relationship between the perceived level of stress and behaviors reported for evacuating during a tunnel fireThe more people feel stressed in a fire situation, the more they should adopt panicky behaviors (*Hypothesis 3*).

This hypothesis was tested separately for each traffic situation. The variables were the participants' reported behaviors in each situation and the perceived level of stress.

To test this hypothesis, we performed a correlation analysis for each traffic situation. For the traffic-jam situation, there was only one behavior that proved to be significantly and positively correlated with the perceived stress level, namely, honking the horn to get others to move forward more quickly (r = .16, p =.05). The higher the stress level, the more users honked their horn to get others to move. In a free-flowing traffic situation, there were two behaviors that were significantly and positively correlated with the perceived level of stress: honking the horn for others to move forward (r = .20, p = .01) and making a U-turn to evacuate the tunnel in the car (r = .17, p = .05).

In short, when people were faced with the risk of a fire and felt stressed, they had a tendency to honk the horn, whether the traffic was moving or at a standstill. This indicates a lack of calmness or panicky behavior. This type of behavior is likely to add to the general confusion and can be seen as unsafe. Another finding was that users in free-flowing traffic would try to make a U-turn with their car. This seems to be evidence of a strong attachment to personal possessions, similar to what we observed in film footage of an actual fire (Kouabenan, Caroly, & Gandit, 2005). These actions can be dangerous if other vehicles are continuing to enter the tunnel, in addition to adding to the general confusion. The stress of this situation apparently leads people to adopt unsafe behaviors. The more stressed people felt, the less they adopted behaviors such as warning others and trying to put out the fire, or calmly evacuating the tunnel.

Analysis of the Effect of Accident Seriousness and Situational Relevance on Explanations Given for Tunnel Fires

Here we wanted to find out if, as observed by numerous authors (Walster, 1966; Shaver, 1970; Shaw & McMartin, 1977; Kouabenan et al., 2001), the seriousness of a fire and its situational relevance would affect explanations given by participants. To test this, we presented participants with five different versions of a tunnel-fire scenario, four resulting from crossing the factor „fire seriousness“ (serious *vs.* not serious) with the factor „perceived situational relevance“ (high *vs.* low), and one that gave no indication of seriousness or situational relevance.

Verification of Variable Manipulation

Before undertaking the analysis, we verified the predictive power of the scenario type on evaluations of fire seriousness and relevance. The seriousness effect and the situational-relevance effect on participants' evaluations were tested separately. The independent variable in both cases was the type of situation; it was a nominal variable with two categories: serious (versions 1 and 2 of the questionnaire) and not serious (versions 3 and 4) for the seriousness variable; high relevance (versions 1 and 3) and low relevance (versions 2 and 4) for the situational-relevance variable.

For testing the perceived seriousness of the scenarios presented to the participants, they were asked to use a five-point scale ranging from 1 (not very serious) to 5 (very serious) to evaluate the seriousness of the fire. The dependent variable was thus the subjective rating of seriousness. The results of the univariate regression analysis showed that the type of situation explained around 62% of the variance in the participants' ratings ($R^2 = .62$). The explanatory power of the predictor, extrapolated at the population level, was approximately the same ($R^2 = .62$). The portion of the variance explained by the predictor was significantly greater than the residual variance ($F(1, 215) = 348.89$, $p = .005$). The contribution of the type of situation presented was significantly different from zero and was very high ($b = .79$, $t = 18.68$, $p = .005$). Thus, the fact of being exposed to a serious fire scenario was a good predictor that the fire's consequences would be rated as serious.

Similarly, for testing the effect of the fire's situational relevance, the participants were asked to use a five-point scale ranging from 1 (very unlikely) to 5 (very likely) to assess the likelihood that they might find themselves in a context similar to that presented in the scenario. Here, the dependent variable was perceived situational relevance. The results of the univariate regression analysis showed that the type of situation explained about 63% of the variance in the participants' ratings of situational relevance ($R^2 = .63$). The explanatory power of the type of situation, extrapolated at the population level, was approximately the same ($R^2 = .63$). The ANOVA on the regression model indicated that the portion of the variance explained by the predictor was significantly greater than the residual variance ($F(1, 215) = 544.05$, $p = .005$). The contribution of the type of situation presented was significantly different from zero and very high ($b = .79$, $t = 19.07$, $p = .005$). Thus, the fact of being exposed to a fire scenario that appeared relevant from the situational standpoint was a good predictor that the fire situation would be rated as relevant.

Nature of the Explanations According to Fire Seriousness and Relevance (Hypothesis 4a and 4b)

We hypothesized that the more serious and relevant the described situation, the more participants should have a tendency to make internal causal attributions that implicate the victims or the people involved in the accident (*Hypothesis 4*).

In order to test this hypothesis, we first verified the reliability of the attribution scales. We obtained a satisfactory reliability index for the external-attribution subscale ($\alpha = .70$) and a relatively satisfactory index for the internal-attribution subscale ($\alpha = .67$). Then, we calculated a single internality index, which we obtained by subtracting the mean external-attribution score from the mean internal-attribution score. With participants making their ratings on a Likert-type scale ranging from 1 to 5, this gave us an index of internality (as our dependent variable) whose minimum value was -4 and whose maximum value was +4. A two-factor analysis of variance was applied to the data thus obtained.

This analysis revealed a simple effect of situation seriousness on explanations ($F(1, 212) = 13.39$, $p < .001$): the more serious the described situation, the more participants gave internal explanations. There was no simple effect of situational relevance on the explanations, nor an interaction between seriousness and relevance. Note that the course of study at the university did not have an effect on the inter-

Table 4. Mean Internal-Attribution Score, by Seriousness and Situational Relevance

	Situational Relevance		
Seriousness	High Relevance	Low Relevance	Control
Serious	1.43	1.25	0.20
Not Serious	0.63	0.53	

Table 5. Mean Internal-Attribution Score, by Seriousness, Situational Relevance, and First-Aid Training

	First-Aid Training		No First-Aid Training	
	High Relevance	Low Relevance	High Relevance	Low Relevance
Serious	1.54	1.42	1.28	0.92
Not serious	0.65	0.80	0.61	0.27
Mean	0.9538		0.6587	
Control	-0.06		0.41	

nal *vs.* external nature of the explanations given, and it did not interact significantly with seriousness or relevance. Hypothesis 4 was thus only partially validated.

Influence of First-Aid Training on Explanations According to Fire Seriousness and Relevance (Hypothesis 4a)

We assumed that, based on their greater knowledge and awareness, participants who had received first-aid training would have a tendency to give fewer internal causal explanations than participants who had not had such training. This difference should be even greater when the fire is serious and the situation is relevant (*Hypothesis 4a*).

These data are presented in Table 5. A three-factor analysis of variance (seriousness, situational relevance, completion of first-aid training or not) revealed that only seriousness had a significant effect on the explanations ($F(1,207) = 11.25$, $p < .001$): participants gave more internal explanations when the situation was serious. There was no simple effect of situational relevance, or of having or not having taken first-aid training. Nor were there any two-way interactions (seriousness/training, seriousness/relevance, relevance/training) or three-way interactions (seriousness/relevance/training). Hypothesis 4a was therefore invalidated.

Influence of Tunnel Use Frequency on Explanations According to the Seriousness and Relevance of the Fire Situation (Hypothesis 4b)

Similarly, we can assume that frequency of tunnel use might influence the explanations given for fires. The more regularly drivers use tunnels, the less they should tend to give internal explanations; conversely, the less they use tunnels, the greater their tendency should be to explain things internally. People who use tunnels on a regular basis may have a tendency to identify with the victims, and, as a self-protective device, make external (or less internal) attributions especially when the accident is serious (*Hypothesis 4b*).

The data for this hypothesis are given in Table 6. The three-factor analysis of variance (seriousness, situational relevance, frequency of tunnel use) revealed a significant effect of seriousness on explanations ($F(1,196) = 5.18$, $p = .020$), a significant interaction between seriousness and relevance ($F(1,196) = 4.24$, $p = .040$), and a three-way interaction between

Table 6. Mean Internal-Attribution Score, by Seriousness, Situational Relevance, and Frequency of Tunnel Use

		Frequency of Tunnel Use			
		At least once or twice a week	Less than once a week	Once or twice a year	Never
Serious	Relevant	1.63	1.61	1.12	**2.28**
	Not Relevant	0.46	1.12	1.35	1.43
Not Serious	Relevant	0.00	-0.00	0.83	1.20
	Not Relevant	**2.15**	1.11	0.02	0.86
Control		0.37	0.76	-0.33	-0.71

seriousness, relevance, and usage frequency ($F(3,196) = 3.998$, $p = .009$). It was the people who never use tunnels who gave the most internal explanations implicating the victims; this pattern was much more pronounced when the situation was serious and relevant ($M = 2.28$). The people who regularly use tunnels gave a large number of internal attributions only when the situation was not serious and not self-relevant (low probability of finding themselves in such a situation) ($M = 2.15$). Hypothesis 4b was thus confirmed.

Analysis of Causal Explanations Given for Non-Evacuation Behavior (Hypothesis 5)

In this last part of our study, we wanted to understand how ordinary people (non-specialists) explain the fact that in fire situations, people do not always evacuate the tunnel, even after they have received a warning or evacuation instructions. To achieve this, we asked the participants to assess the causes of non-evacuation behaviors observed during tunnel fires. They had to use a 5-point Likert-type scale to assess the causal role of a series of possible causal factors, sixteen of which were external and twelve of which were internal. Some examples of the internal explanations proposed are: „Users stay in their cars to wait for official instructions“, „Users don't think they are really in danger“, and „Users don't want to leave their personal possessions“. Some examples of external explanations are: „Unclear evacuation instructions given by rescue personnel“, „Lack of initial information about the evacuation procedure“, and „Poor visibility due to smoke“.

As stated above, we assumed that participants would make more internal than external attributions to explain non-evacuation behavior during road-tunnel fires (*Hypothesis 5*).

In order to test this hypothesis, we again verified the reliability of the attribution scales. We obtained a very satisfactory reliability index for the external-attribution scale ($\alpha = .85$) and a relatively satisfactory reliability index for the internal-attribution scale ($\alpha = .66$). Then, we calculated a single index of internality, which was obtained by subtracting the mean score of external attributions from the mean score of internal attributions. With participants giving their ratings on a Likert-type scale from 1 to 5, we obtained an index of internality (as our dependent variable) whose minimum value was -4 and whose maximum value was +4. An analysis of variance was applied to the data thus obtained.

In general, users made more internal causal attributions ($M = 3.28$) than external ones ($M = 2.53$), $t(192) = 11.493$, $p < .001$. The mean difference between internal and external explanations was positive and equal to + 0.75. Those participants taking engineering courses did not give significantly more internal explanations than the psychology majors did ($M = .77$ for engineers *vs.* $M = .73$ for psychology majors; $F(1,191) = 0.09$, *ns*). Likewise, the explanations provided by the women and the men did not differ significantly ($M = .77$ for women *vs.* $M = .66$ for men; $F(1,191) = 0.61$, *ns*). There was also no significant effect of first-aid training ($M = .76$ *vs.* $M = .73$), nor an interaction between these three factors (course of study, gender, first-aid training).

We can see, then, that whatever their gender or training, the participants believed that if tunnel users do not evacuate a tunnel after being warned, it is due more to internal factors implicating the users, namely, trying to get away in their car ($M = 4.14$), waiting to see what others do ($M = 3.99$), fear of being exposed to danger by leaving one's car ($M = 3.85$), desire to not leave one's possessions behind ($M = 3.64$), feeling powerless and panicky in the face of a fire ($M = 3.37$), etc. Although the effect of internal factors was predominant, it seems useful to also mention some of the external factors that were considered by the users as equally important: lack of initial information about evacuation ($M = 3.92$), ineffective warning procedures ($M = 3.92$), poor visibility due to smoke ($M = 3.88$), lack of conspicuous signs indicating emergency exits ($M = 3.79$), disorganized rescue operations ($M = 3.74$), unclear instructions ($M = 3.55$), inaudible alarms ($M = 3.55$), etc.*

* Item means were calculated on the basis of the original 1-to-5 scales.

Discussion and Conclusion

What stands out from the present study is that the behavior of users in the event of a road-tunnel fire differs according to the traffic situation. When traffic is moving well, users tend to engage in riskier behaviors than when traffic is congested (traffic jam). Also, in a free-flowing traffic situation, people exhibit more nervousness, tending to honk their horns or make U-turns with their vehicle. This only adds to the general chaos and confusion, and increases the risk of collisions with other vehicles. These results run counter to those found by Hennessy and Wiesenthal (1997), who noted that traffic congestion on the road accentuates drivers' stress. In our study, on the contrary, the constraints imposed by the impossibility of moving ahead due to heavy traffic encouraged the users to be patient (telephone and wait for help) or to follow instructions regarding evacuation (use an emergency exit) or self-protection (find a shelter).

We found similar results when taking the perceived level of stress into account. In both situations, the users' perceived stress led them to adopt unsafe behaviors. However, contrary to Hennessy and Wiesenthal's (1997) findings, this relationship was stronger in a free-flowing traffic situation than in congested traffic. In flowing traffic, people tended to honk their horn or make a U-turn when they experienced stress. In congested traffic stressed-out people, by contrast, were less likely to adopt behaviors such as warning others, trying to put out the fire, or evacuating the tunnel by the recommended routes. In summary, when people felt stressed they tended to adopt behaviors that were less safety-conscious, especially when traffic was moving freely. However, this difference between our results and those of Hennessy and Wiesenthal (1997) could be due to the fact that these authors studied driving in real driving settings while our studies examined driving in hypothetical emergencies.

As a whole, the behaviors seemed consistent within each situation, but they were not always safety-conscious. For example, it was unfortunate that those who tried to evacuate the tunnel on foot did not think to telephone rescue personnel before doing so. We also noted a certain behavioral rigidity among many of the users, who tended to adopt similar behavior in all situations. For example, users who decided to telephone and wait for rescuers or to search for a shelter were inclined to adopt the same behavior whether the traffic was moving freely or blocked. Finally, we noted in both situations that few people wanted to take the risk of trying to put out the fire, which would probably have been a wise move given the speed at which fires tend to spread in a confined space such as a road tunnel (Ministère de l'équipement, des transports et du logement, Ministère de l'intérieur, 1999).

When users decided to evacuate the tunnel on foot, the chosen self-rescue route did not differ significantly by traffic situation, by the users' experience with tunnels, or even by whether they had taken first-aid training. The preferred route was the emergency exit. This finding contrast with Boer's (2002) results, and shows that in general, in the case of evacuation by foot, users have a tendency to adopt behaviors that conform to safety standards. This result is interesting and underlines the fact that users do not always act irrationally. Note, however, that this route was chosen significantly more often by women, who are probably more cautious than men, as often shown in the area of road safety (Simon & Corbett, 1996; Turner & McClure, 2003).

Regarding the naive explanations provided by participants for these fires, situation seriousness had a very strong effect. The more serious the situation, the more participants tended to give internal explanations. We did not observe a simple effect of situational relevance, but it did interact with seriousness. The more serious and relevant the situation, the more users tended to give internal explanations. Likewise, there was a three-way interaction between seriousness, relevance, and frequency of tunnel use. People who never travel through road tunnels gave more explanations that implicated the people involved as the situation become more serious and more relevant, and they did this more than people who regularly use tunnels. This result goes along with the findings obtained by Shaver (1970), Shaw and McMartin (1977), and Kouabenan et al. (2001), which showed that accident seriousness and situational relevance increase defensive internal explanations, especially when participants do not perceive themselves as similar to the actors in the scenarios being described. It is quite possible that people who do not use tunnels much do not identify with fire victims or with people described in the tunnel-fire scenarios. On the other hand, people who regularly use tunnels, and can presumably identify with the people described, may give internal explanations only when the situation is not relevant to them, i.e., when there was little chance they would find themselves in that situation. Since we did not directly test perceived personal relevance in this study, the above explanation is only a hypothesis, albeit a very plausible one.

Finally, the participants stated several reasons why people might not evacuate according to official instructions when the warning is given. The most commonly cited explanations were internal ones implicating the users themselves: waiting to see what others are going to do, wanting to stay with their possessions, fear of being exposed to danger after leaving their vehicle, or feeling powerless in the face of a fire. The uncertainty of the situation and incomplete knowledge of evacuation and rescue procedures put users in a potentially ambiguous situation. Indeed, while internal motivations were predominant in general, several external motivations were also mentioned. Notably, participants felt that tunnel evacuation could be impeded by a lack of information about evacuation procedures or emergency exits, a lack of clarity as to emergency instructions or as to how rescue operations are being organized, or smoke that limits visibility and prevents people from finding emergency exits.

These results demonstrate the importance of taking the beliefs and naive explanations of the general public into account when trying to develop programs for promoting safer behavior. Several lessons can be drawn from this. When it comes to educating road-tunnel users and increasing their awareness, it is important to inform them about safety-conscious behaviors during a fire while at the same time cautioning them against displaying panic, which can complicate rescue operations. In addition, tunnel users should be cautioned against being overly attached to personal possessions at the risk of human lives, and also against taking a passive attitude or underestimating their own personal risk. The goal should be to combat people's false beliefs and make them aware of their own vulnerability in the face of tunnel fires, which may spread very rapidly. Finally, it is important to teach people to handle stress in such situations, and to convince them that it is possible to make good behavioral choices that will help them save their own lives. These results highlight the necessity of improving both visual and aural systems aimed at informing and warning users in the event of a tunnel fire (signs indicating emergency exits, shelters, and emergency call boxes, improvement of the *automatic incident-detection system* that utilizes cameras to identify vehicles or objects immobilized on the pavement, etc.). We know that when an incident is detected at a central control post, users are not informed through a public address system but via an *FM radio transmitter* (Kouabenan, Gandit, & Caroly, 2006; Gandit, Kouabenan, & Caroly, 2009). This method of warning users is not effective for people who do not have an FM radio or who do not have their radio turned on at the time of the incident. For this reason, it is critical to consider using an audible warning device that can quickly alert all users and not be dismissed as a false alarm. Furthermore, it is important to better educate users about how to evacuate tunnels during a fire and about what warning signals to watch for, and to improve evacuation instructions in general. This might require a training session of several hours for the most frequent tunnel users. For the general public, carefully targeted fire-safety instructions could be given out on flyers or information sheets at tunnel entrances or highway rest areas.

To end, we need to mention that one of the potential limitations of the present study remains in the fact that we work with hypothetical emergency situations and mostly with young participants, even if these hypothetical cases derived from tunnel fires in real traffic settings. However the results obtained are very complementary of those we obtain with very experienced tunnels users (Gandit, Kouabenan, & Caroly, 2009). We may also notice that the stress scale that we use in this study is a general global stress scale. It would be interesting to examine in a future study if we obtain the same results with a more situational stress scale.

References

Boer, L.C. (2002). *Behaviour by motorists on evacuation of a tunnel*. T.N.O. Report. TM-02-C034.

Crawford, J.R. & Henry, J.D. (2003). The Depression anxiety stress scales (DASS): Normative data and latent structure in a large non-clinical sample. *British Journal of Clinical Psychology, 42,* 111-131.

Dejoy, D.M. (1989). The optimism bias and traffic accident: Risk perception. *Accident Analysis and Prevention*, *21*, 333-340.

Dejoy, D.M. (1994). Managing safety in the workplace: An attribution theory analysis and model. *Journal of Safety Research*, *25,* 3-17.

Gandit, M., Kouabenan, D.R. & Caroly, S. (2009). Road-Tunnel Fires: Risk Perception and Management Strategies Among Users*. Safety Science, 47, 105-114.*

Hamilton, V.L. (1986). Chains of Command: Responsibility Attribution in Hierarchies *Journal of Applied Social Psychology*, *16*, 118-138.

Hennessy, D.A. & Wiesenthal, D. L. (1997). The relationship between traffic congestion, driver stress and direct versus indirect coping behaviours. *Ergonomics, 40*, 348-361.

http://lesrapports.ladocumentationfrancaise.fr/BRP/994000632/0000.htm#partie1.

Kouabenan, D.R. (1985a). L'analyse des attributions causales. *Le Travail Humain*, *48*, 1-17.

Kouabenan, D.R. (1985b). Degree of involvement in an accident and causal attribution. *Journal of Occupational Accidents*, *7*, 187-194

Kouabenan, D.R. (1990). Les accidents de la circulation en Côte d'Ivoire: voies d'analyse et de recherche. *Recherche Transports Sécurité (R.T.S.), 25*, 29-38.

Kouabenan, D.R. (1998). Beliefs and the perception of risks and accidents. *Risk Analysis : An International Journal, 18* , 243-252.

Kouabenan, D.R. (1999). *Explication naïve de l'accident et prévention*. Paris: Presses Universitaires de France.

Kouabenan, D.R. (2000). Explications ordinaires des accidents, perception des risques et stratégies de protection. *Pratiques psychologiques, 1,* 85-97.

Kouabenan, D.R. (2006a). Management de la sécurité: rôle des croyances et des perceptions. In C. Lévy-Léboyer, M. Huteau, C. Louche & J. P. Rolland, *RH: Les apports de la psychologie du travail, tomme 2* : Management des organisations (pp. 361-383). Paris: Les Editions d'Organisation

Kouabenan, D.R. (2006b). Des facteurs structurants aux biais ou illusions dans la perception des risques. In D.R. Kouabenan, B. Cadet, D. Hermand, & Muñoz Sastre, M.T. (Eds), *Psychologie du risque: Identifier, évaluer et prévenir les risques* (pp. *125-145). Bruxelles: De Boeck Université.*

Kouabenan, D.R. (2006c). Beliefs and naive causal explanations of accidents and prevention. In P. Huang, S. Li, C. Zheng & Mao, Z. (2006), *Progress in Safety Science and Technology (pp.24-29).* Beijing: Science Press, Science press USA, Inc.

Kouabenan, D.R. (2009). Role of beliefs in accident and risk analysis and prevention. *Safety Science, 47, 767-776*.

Kouabenan, D.R., Caroly, S. & Gandit, M. (2005). Comprendre la perception des risques et les modalités de gestion des incendies dans les tunnels routiers par les usagers: une voie pour une stratégie de prévention durable. In *Ergonomie et développement durable* (pp. 192-202), Actes du 40e congrès de la Société d'Ergonomie de Langue Française (SELF), Saint Denis de la Réunion, 21-23 September 2005. Editions du réseau ANACT.

Kouabenan, D.R., Gandit, M. & Caroly, S. (2006). Tunnel-fire risk perception and management strategies among users. In P. Huang, S. Li, C. Zheng & Z. Mao (2006), *Progress in Safety Science and Technology (pp.901-904).* Beijing: Science Press, Science press USA, Inc.

Kouabenan, D.R., Gilibert, D., Médina, M. & Bouzon, F. (2001). Hierarchical position, gender, accident severity and causal attributions. *Journal of Applied Social Psychology, 31, 553-575*.

Lacroix, D. V., & Dejoy, D. M. (1989). Causal attributions to effort and supervisory response to workplace accidents. *Journal of Occupational Accidents*, *11*, 97-109.

Lazarus, R.S. & Folkman, S. (1984). *Stress, Appraisal, and Coping*. New York, NY: Springer.

Lovibond, S.H., & Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales.* Sydney: Psychology Foundation (see also http://www.psy.unsw.edu.au/Groups/Dass/).

Ministère de l'équipement, des transports et du logement, Ministère de l'intérieur (1999). *Mission administrative d'enquête technique sur l'incendie survenu le 24 mars 1999 au tunnel routier du Mont Blanc. Rapport d'étape du 13 Avril 1999*.

Mitchell T.R. & Wood, R.E. (1980). Supervisor's responses to subordinate poor performance. A test of an attributional model. *Organizational Behavior and Human Performance, 25*, 125-138.

Nieuwenhuijsen, T., Boer, A.G.E.M., Verbeek, J.H.A. M, Blonk, R.W.B., & van Dijk, F. J. H. (2003). The Depression Anxiety Stress Scales (DASS): detecting anxiety disorder and depression in employees absent from work because of mental health problems. *Occupational and Environmental Medicine, 60*, 77-82.

Niskanen, T. (1994). Assessing the safety environment in work organization of road maintenance jobs. *Accident Analysis and Prevention*, *26*, 27-39.

Proulx, G. (1993). A stress model for people facing fire. *Journal of Environmental Psychology, 13,* 137-147.

Salminen, S. (1992). Defensive attribution hypothesis and serious occupational accidents. *Psychological Reports*, *70*, 1195-1199.

Shaver, K.G. (1970). Defensive attribution: effects of severity and relevance on the responsibility assigned for an accident. *Journal of Personality and Social Psychology*, *14*, 101-113.

Shaw, J.I. & McMartin, J.A. (1977). Personal and situational determinants of attribution of responsibility for an accident. *Human Relations*, *30*, 95-107.

Shields, T.J. & Boyce, K. (2004). Towards developing an understanding of human behaviour in fire tunnels. In *Human Behaviour in Fire. Public Fire Safety, Professionals in Partnership, 3rd International Symposium* (pp. 215-228). London: Interscience Communication.

Simon, F. & Corbett, C. (1996). Road traffic offending, stress, age and accident history among male and female drivers. *Ergonomics*, *39*, 757-780.

Turner, C., & McClure (2003). Age and gender differences in risk-taking behaviour as an explanation for high incidence of motor vehicle crashes as a driver in young males. *Injury Control and Safety Promotion, 10(3),* 123-30.

Walster, E. (1966). Assignment of responsibility for an accident. *Journal of Personality and Social Psychology, 3*, 73-79.