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Alexandra Fort, Myriam Evennou, Christophe Jallais, Barbara Charbotel, Antonio Hidalgo-Muñoz. A prevalence study of driving anxiety in France. *Journal of Transport and Health*, 2023, 32, pp.101657. 10.1016/j.jth.2023.101657 . hal-04182467

**HAL Id: hal-04182467**

**<https://univ-eiffel.hal.science/hal-04182467v1>**

Submitted on 17 Aug 2023

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ELSEVIER

Contents lists available at ScienceDirect

## Journal of Transport &amp; Health

journal homepage: [www.elsevier.com/locate/jth](http://www.elsevier.com/locate/jth)

## A prevalence study of driving anxiety in France

Alexandra Fort<sup>a,\*</sup>, Myriam Evennou<sup>a</sup>, Christophe Jallais<sup>a</sup>, Barbara Charbotel<sup>b</sup>, Antonio Hidalgo-Muñoz<sup>c</sup><sup>a</sup> Laboratory Ergonomics and Cognitive Sciences Applied to Transport, Univ Gustave Eiffel, Univ Lyon, TS2-LESCOT, F-69675, Lyon, France<sup>b</sup> Université de Lyon, Université Lyon 1, Université Gustave Eiffel-IJsttar, Umrestte, UMR T 9405, Domaine Rockefeller, 8 Avenue Rockefeller, 69008, Lyon, France<sup>c</sup> Department of Basic Psychology, Psychobiology and Methodology of Behavioural Science, University of Salamanca, Salamanca, Spain

## ARTICLE INFO

## Keywords:

Automobile driving  
Worry  
Avoidance  
Fear  
Survey

## ABSTRACT

**Introduction:** Driving anxiety can be deleterious for individual mobility, driving behaviour, and well-being. This phenomenon seems to be relatively common in all industrialized societies but its extent is still poorly estimated. New Zealand studies report a prevalence of driving anxiety from 25 to 69% according to the age range of the population considered (18–87; 55–72; or over 65). In addition, these data agree on an over-representation of women among people concerned by this anxiety. Up to now, no data exists on the prevalence of this phenomenon in France. The major aim of this study is to quantify the proportion of the French population concerned by driving anxiety. **Methods:** For that, a cross-sectional study using an online survey has been conducted among 5000 French adults (from 18 to 89 years old) in June 2021. The sample is representative of the French population in gender, age, occupational categories, and place of residence. **Results:** The main results reveal that nearly 80 % of our sample express at least a minimal level of driving anxiety (on a scale from 0 to 10). The mean intensity of reported driving anxiety is higher for women than for men. Moreover, the intensity is negatively correlated with age. Finally, the intensity of reported driving anxiety is on average higher for people living in large urban areas (e.g. Paris) and for people belonging to low-qualified occupational categories. **Conclusions:** These results highlighted the extent of driving anxiety in France. Future studies should assess its impact on quality of life as well as on skills and driving behavior according to its intensity.

## 1. Introduction

In our industrialized modern societies, car driving is an important factor of mobility and autonomy. For many, it is an essential ability that contributes to the quality of life by allowing access to a wide variety of activities and, for some, access to employment. However, despite its routine nature, this activity presents safety issues that can cause some anxiety. This driving anxiety can range from a simple apprehension of certain driving situations to a driving phobia (amaxophobia) that prevents people from driving or even getting into a car (Taylor et al., 2007), impacting mobility. Driving avoidance behavior, whether it is partial or total, may have consequences in terms of independence, with possible impact at personal and professional levels (Costa et al., 2014; Fort et al., 2021;

\* Corresponding author. Univ Eiffel, TS2, LESCOT 25, avenue François Mitterrand, Case24, F-69675, Bron Cedex, France.

E-mail addresses: [alexandra.fort@univ-eiffel.fr](mailto:alexandra.fort@univ-eiffel.fr) (A. Fort), [myriam.evennou@univ-eiffel.fr](mailto:myriam.evennou@univ-eiffel.fr) (M. Evennou), [christophe.jallais@univ-eiffel.fr](mailto:christophe.jallais@univ-eiffel.fr) (C. Jallais), [barbara.charbotel@univ-lyon1.fr](mailto:barbara.charbotel@univ-lyon1.fr) (B. Charbotel), [arhidalgom@usal.es](mailto:arhidalgom@usal.es) (A. Hidalgo-Muñoz).

<https://doi.org/10.1016/j.jth.2023.101657>

Received 16 January 2023; Received in revised form 2 May 2023; Accepted 28 June 2023

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Stephens et al., 2020). Also, it has been shown that driving anxiety may have an impact on self-appraisal, and well-being, because of the feeling of one's weakness, and shame related to driving anxiety and associated avoidance behavior (Fort et al., 2021).

Driving anxiety was first examined from a clinical perspective, to understand the long-term consequences to have been involved in a road crash (Hickling and Blanchard, 1992; Taylor and Koch, 1995). These works have led to a better understanding of the psychological consequences of road crashes. However, since these works, research has shown that it is not necessary to have been involved in a car crash to develop a level of driving anxiety that can have an impact on daily life (Hidalgo-Muñoz et al., 2021; Stephens et al., 2022; Taylor and Deane, 1999).

In 2019, a first survey was conducted in France but only focused on people directly concerned by driving anxiety (Collette, 2019; Fort et al., 2021; Hidalgo-Muñoz et al., 2021). The results of this survey confirmed the data in the literature that driving anxiety can have very different sources. Only 7.7% of this sample considered that the source of their anxiety was due to involvement in a road crash, the main source being having had a panic attack while driving (13.1%) followed by criticism from a passenger or driving instructor (8.1%). It should also be noted that 42.7% did not remember a particular event that may have caused this anxiety (Hidalgo-Muñoz et al., 2021). Another important finding of this survey is that even people reporting a quite low level of anxiety (below 5 out of 10) reported that their daily and professional lives were impacted. In other words, the impact of driving anxiety is significant even when the level of anxiety experienced is low (Fort et al., 2021; Stephens et al., 2020).

Nowadays, there is still very little data on the prevalence of this phenomenon in the world and no data in France. The only general population prevalence study was conducted in New Zealand. The data were obtained through a survey of a random sample of adults on the electoral roll. The 441 respondents were 18–87 years old. On a YES/NO question, nearly 12% of the respondents declared to be anxious about driving. However, when the same 441 respondents were asked to report their level of driving anxiety on a scale from 0 ("not at all") to 10 ("extremely"), only 31% considered themselves not at all anxious (score 0 or 1), while 52% declared having mild anxiety about driving (score between 2 and 4) and 16% moderate to severe anxiety (score between 5 and 10) (Taylor, 2018). Thus, in this survey, at least two-thirds of drivers would experience anxiety related to their driving activity. Another New Zealand study was conducted with a larger sample (N = 2491) focused on a population aged 55–72 years, with 53% of women. 20% of this sample reported mild anxiety (between 1 and 4) and 5.5% moderate to severe anxiety (between 5 and 10) (Taylor et al., 2011). Finally, within a population of 65 years and older (N = 1170), with about 53% of men, Taylor and collaborators (2018) observed that 27% reported mild driving anxiety (1–4) and about 11% moderate to severe driving anxiety (5–10). Thus, within these two older samples, about one-third reported driving anxiety. In addition, on average, within these two last studies, women reported a higher score of driving anxiety than men and the proportion of women was higher in the mild and moderate to severe driving anxiety groups.

In light of these data, it seems that driving anxiety is a fairly common phenomenon, which may affect women to a greater extent and which may have repercussions even when its intensity is moderate. The first step to better understand the extent of this phenomenon is to estimate more precisely the proportion of the general population concerned by driving anxiety. For this, we considered the French population for which no data is available. We, therefore, wanted to quantify not only the proportion of the French population concerned by driving anxiety in general, but also according to some demographical characteristics (age, gender, occupational status, place of residence). We also looked at the potential onsets of this phenomenon as well as at the main specific driving situations that are problematic for people with driving anxiety. The reasons for that are 1) to determine whether there are any possible levers to limit driving anxiety or prevent it from taking hold, and 2) to determine which specific driving situations need more attention from intervention perspectives.

## 2. Method

### 2.1. Participants

The recruitment of 5000 respondents as well as the recording of the data has been assigned to a polling company (Lightspeed Research Limited®) which guarantees the anonymization of the respondents. The sample is representative of the French population aged 18 years or over in terms of age, gender, occupational categories, and place of residence based on the 2021 indicators from the French national institute of statistics and economic studies (*Institut national de la statistique et des études économiques*, INSEE: <https://www.insee.fr/>).

The data were recorded in June 2021 using an online platform. Ethical approval was obtained from the ethical committee of our university. Completing the questionnaire implied consent to participate in the survey.

### 2.2. Questionnaire and procedure

The questionnaire used in this survey was composed of 4 parts.

The first part collected demographic characteristics. This part ensures that the sample was representative of the French population on 5 criteria:

- Gender,
- Age (6 classes: 18–24, 25–34, 35–44, 45–54, 55–64, ≥65),
- French socio-professional categories (3 classes: *SPC+*: Managerial and highly qualified worker, self-employed and farm operator and intermediate profession; *SPC-*: employees and factory workers; *Inactive*: retired people, students, other unemployed people),

- Place of residence through geographical information (5 classes: Paris and surroundings, Eastern Paris area and East and North regions, Western Paris area and West region, Southwest region, Southeast region, and Mediterranean area) and
- Agglomeration sizes (3 classes: < 5000 inhabitants, from 5000 to 49 999 inhabitants and  $\geq 50\ 000$  inhabitants).

The second part collected data about driving experience: driving licenses held, the implication in road crashes with and without bodily consequences, and frequency of driving. Respondents are also asked to report how much they apprehend 18 driving-specific situations and how often they avoid the same 18 situations, on a 5-Likert scale, from 0 (not at all/never) to 4 (extremely/all the time). These situations are listed in Table 2 (see part 3.4.2).

The third part of the questionnaire was dedicated to driving anxiety. Respondents had to report the level of driving anxiety they feel on a 0 (not at all anxious) to 10 (extremely anxious) scale as done in previous studies (Fort et al., 2021; Stephens et al., 2020; Taylor, 2018). If the answer to this question was equal to or over 1, a question about the potential onsets of this anxiety was asked. For that, respondents had to determine for 9 potential onsets how much they think each one may have contributed to their driving anxiety on a 0 (not at all) to 4 (extremely) scale. These potential onsets were: to have been involved in a road crash, to have been a victim of a panic attack while driving, to have been a witness to a road crash, to have been informed about road dangers (through prevention campaigns for instance), to have been confronted with a vehicle failure, to lack self-confidence, to lack confidence in the other road users, to have had his/her driving skills criticized by a passenger or instructor, to have a close relative concerned by driving anxiety.

Finally, the fourth and last part of the questionnaire was about general trait anxiety through the short version of the State-Trait Anxiety Inventory STAIT-5 developed by Zsido et al. (2020). According to the authors, individuals scoring  $\geq 14$  on this scale should be considered potentially clinically anxious.

The online questionnaire took about 10 min to be filled in.

### 2.3. Data analyses

Data analysis were conducted with SPSS v.26 for Windows and SAS. There were no missing values in the assessed variables.

A first descriptive analysis detailed the composition of our sample according to the expected demographic criteria. Then, several ANOVA were conducted to compare the level of driving anxiety reported according to gender, age, socio-professional categories, French regions of residence, and size of residence agglomeration. Pearson coefficient correlation analysis was carried out to calculate the association between the level of driving anxiety and age, the size of the agglomeration, and the level of general anxiety.

To better know the main driving situations that might be problematic for people concerned with driving anxiety, a second descriptive analysis was conducted to identify the three situations the most apprehended as well as the three situations the most avoided from the 18 driving situations proposed (see Table 2).

Finally, the role of having been involved in road crashes on driving anxiety was analyzed using an ANOVA comparing the mean level of driving anxiety according to the history of road crashes (no, with or/and without bodily consequences).

**Table 1**

Description of our sample according to the demographic criteria of representativeness of the sample: comparison of study-population values to 2021 indicators of a French national administrative database (INSEE).

	Frequency (n)	% in study-population	% in the French population
<b>Gender</b>			
Male	2400	48	48
Female	2600	52	52
<b>Age (years)</b>			
18–24	529	11	10
25–34	768	15	15
35–44	786	16	16
45–54	866	17	17
55–64	802	16	16
$\geq 65$	1249	25	26
<b>Socio-professional categories</b>			
SPC+	1386	28	28
SPC-	1589	32	28
Inactive	2025	41	44
<b>French regions of residence</b>			
Paris and the surrounding area	973	20	18
Western Paris area + West	1099	22	23
Eastern Paris area + North + East	1198	24	23
Southwest	546	11	11
Southeast + Mediterranean area	1184	24	25
<b>Agglomeration size (Number of residents)</b>			
<5000	1650	33	38
5000–49 999	1414	28	39
>50 000	1936	39	24

**Table 2**  
Mean scores (and Standard Deviation) of apprehension and avoidance of 18 specific driving situations.

	Apprehended situations			Avoided situations		
	Mean score /4			Mean score /4		
	All (N=3907)	Male (n=1779)	Female (n=2127)	All (n=3406)	Male (n=1595)	Female (n=1811)
Driving in general	1.31 (±1.16)	1.0 (±1.12)	1.24 (±1.18)	0.73 (± 0.98)	0.64 (±0.95)	0.8 (±1.01)
Overtaking/passing	1.46 (±1.17)	1.27 (±1.13)	1.61 (±1.18)	1.06 (± 1.04)	0.92 (±0.99)	1.19 (±1.07)
Driving on a motorway	1.34 (±1.3)	1.05 (±1.19)	1.59 (±1.35)	0.94 (±1.17)	0.75 (±1.05)	1.11 (±1.25)
Driving in heavy traffic	1.96 (±1.2)	1.67 (±1.16)	2.14 (±1.19)	1.3 (± 1.11)	1.14 (±1.09)	1.44 (±1.11)
Merging into traffic	1.55 (±1.18)	1.34 (±1.13)	1.73 (±1.18)	0.88 (±1.0)	0.75 (±0.95)	1.00 (±1.04)
Driving in a city	1.52 (±1.23)	1.36 (±1.18)	1.65 (±1.26)	0.99 (±1.09)	0.88 (±1.04)	1.08 (±1.12)
Driving in an unfamiliar car	1.98 (±1.02)	1.64 (±1.16)	2.27 (±1.17)	1.56 (±1.24)	1.23 (±1.14)	1.85 (±1.26)
Driving at night	1.96 (±1.27)	1.63 (±1.22)	2.23 (±1.23)	1.57 (±1.27)	1.31 (±1.18)	1.8 (±1.3)
Driving through a tunnel	1.29 (±1.19)	1.1 (±1.12)	1.43 (±1.23)	0.82 (±1.04)	0.68 (±0.96)	0.95 (±1.09)
Driving in the fog	2.4 (±1.11)	2.18 (±1.11)	2.58 (±1.09)	1.71 (±1.18)	1.53 (±1.14)	1.88 (±1.19)
Driving in the rain	2.3 (±1.14)	2.07 (±1.14)	2.5 (±1.11)	1.64 (±1.16)	1.43 (±1.12)	1.83 (±1.16)
Driving under stress for reasons other than driving	1.88 (±1.14)	1.67 (±1.1)	2.06 (±1.15)	1.46 (±1.13)	1.31 (±1.09)	1.59 (±1.14)
Driving with passengers	1.18 (±1.15)	1.03 (±1.1)	1.31 (±1.17)	0.78 (±0.98)	0.71 (±0.95)	0.84 (±0.99)
Driving with a passenger who criticizes your driving	2.2 (±1.25)	1.95 (±1.25)	2.41 (±1.21)	1.73 (±1.3)	1.57 (±1.28)	1.87 (±1.29)
Riding in a car as a passenger	1.42 (±1.18)	1.54 (±1.17)	1.32 (±1.19)	0.96 (±1.05)	1.05 (±1.09)	0.88 (±1.00)
Driving under fatigue	2.35 (±1.09)	2.24 (±1.09)	2.44 (±1.07)	2.05 (±1.15)	1.96 (±1.15)	2.14 (±1.15)
Driving at intersections	1.37 (±1.13)	1.24 (±1.1)	1.47 (±1.15)	0.81 (±0.99)	0.73 (±0.99)	0.88 (±1.0)
Driving on an unfamiliar road	1.59 (±1.7)	1.33 (±1.1)	1.81 (±1.19)	1.01 (±1.07)	0.83 (±1.0)	1.17 (±1.11)

*The 3 higher scores for apprehension and avoidance are marked with shaded areas.*

### 3. Results

#### 3.1. Sample characteristics

As reported in Table 1, the sample was representative of the French population through 4 of the 5 target criteria: gender, age, socio-professional categories, and French regions of residence. However, the sample deviates from the French repartition on the criterion of agglomeration size. For this reason, we have chosen to work with a weighted data basis to be as close as possible to the representativeness of the French population on this criterion too. The quality of the weighting provided by Lightspeed® meets the required levels with a Rim Weighting Efficiency coefficient of 81.2%, a maximum weighting coefficient of 3.42, and a minimum coefficient of 0.29.

#### 3.2. Extent of driving anxiety in France

Fig. 1 shows the distribution of our sample according to the level of anxiety reported, in the overall population with a gender

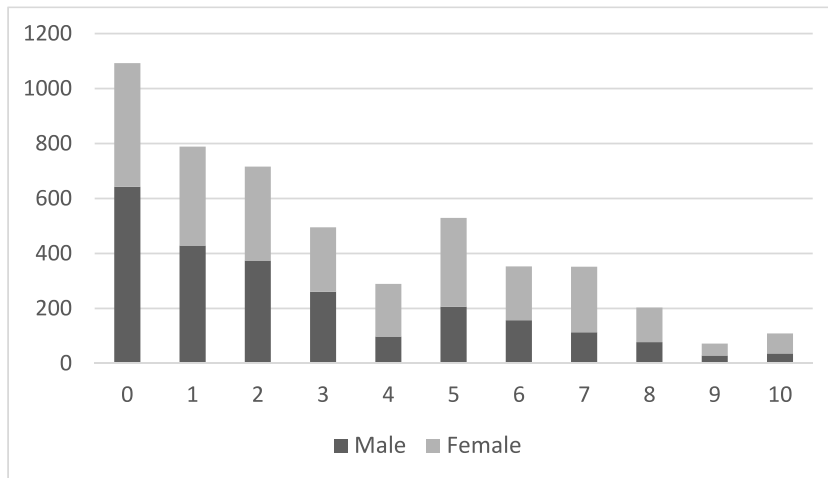


Fig. 1. Distribution of the population according to the reported level of anxiety and according to gender.

breakdown. The mean level of driving anxiety in our sample was  $3.09 \pm 2.75$  (out of 10).

In our sample, 1093 persons reported no driving anxiety at all (21 % of our sample) (score 0). In other words, 3907 persons (79%) considered themselves to have a low level to a high level of driving anxiety (from 1 to 10).

To be able to compare our results with those of the international literature, the data were also grouped according to the breakdown of Taylor (2018), for whom those scoring driving anxiety to 0 and 1 were considered as non-anxious, those scoring between 2 and 4, mildly anxious and those scoring between 5 and 10 were considered moderately to severely anxious. In our sample, people were respectively 37.6%, 30%, and 32.4% in each one of these categories.

### 3.2.1. Gender and driving anxiety

The mean level of reported driving anxiety was  $2.62 (\pm 2.6)$  for men and  $3.53 (\pm 2.82)$  for women. This difference is significant ( $F(1,4997) = 138.83, p < .0001$ ). As illustrated by Fig. 1, while a higher number of men than women reported low levels of anxiety (1, 2, or 3), they were less likely to report anxiety levels of 4 or higher.

### 3.2.2. Age and driving anxiety

Concerning the repartition of the population through the levels of driving anxiety according to age, results revealed a negative correlation: the older the people, the less intense their driving anxiety ( $r = -0.195, p < .01$ ) (Fig. 2A). In addition, a two-way ANOVA on driving anxiety with 2 between factors (gender and age) revealed an interaction effect ( $F(5,4988) = 10.608, p < .00001$ ): while men and women reported comparable levels of anxiety before the age of 35, women over the age of 35 reported higher levels of anxiety than men.

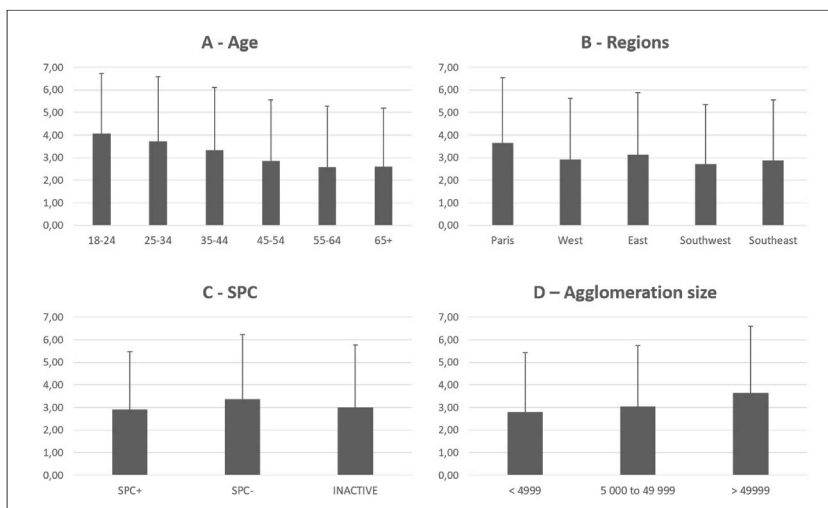


Fig. 2. Mean reported level of driving anxiety according to age (A), SPC (B), French regions (C) and agglomeration size (D).

### 3.2.3. SPC and driving anxiety

Concerning the SPC, results revealed that the mean score of driving anxiety was significantly different according to the 3 levels of the French socio-professional categories ( $F(2,4996) = 12.616, p < .00001$ ) (Fig. 2B). People in the SPC- reported a higher level of driving anxiety (mean score =  $3.37 \pm 2.86$ ) than people in the SPC+ (mean score =  $2.90 \pm 2.59; p < .001$ ) and, than the inactive people (mean score =  $3.00 \pm 2.76; p < .001$ ).

### 3.2.4. French regions

Results revealed significant differences in the level of driving anxiety according to the French regions ( $F(4,4994) = 16.362, p < .00001$ ). Comparisons between regions revealed that people living in Paris and its surroundings area reported a significantly higher level of driving anxiety (mean score =  $3.66 \pm 2.88$ ) than people living in all the other regions (mean scores for Paris west and west:  $2.93 \pm 2.69$ ; Paris East and East:  $3.13 \pm 2.75$ ; Southwest:  $2.72 \pm 2.63$ ; Southeast:  $2.88 \pm 2.69$ ) (Fig. 2C).

### 3.2.5. Agglomeration size and driving anxiety

The mean level of driving anxiety was significantly different according to the size of the community of residence ( $F(2,4996) = 34.691, p < .0001$ ) (Fig. 2D): the larger the size of the community of residence, the higher the average level of driving anxiety (<5000 inhabitants:  $2.8 \pm 2.62$ ; between 5000 and 49 999 inhabitants:  $3.04 \pm 2.72$ ; 50 000 or more inhabitants:  $3.65 \pm 2.95$ ). Paired comparisons revealed that all differences were significant (See Fig. 2D). Thus, there was a significant correlation between the size of the agglomeration and driving anxiety ( $r = 0.121, p < .01$ ).

## 3.3. Apprehension and avoidance

### 3.3.1. Avoidance

When looking at the frequency of driving among those with a car driving license, 129 respondents indicated that they never drove. In this sub-group, 67.4% were female and the mean driving anxiety was  $5.85 (\pm 3.18)$ . Besides, 59 respondents (average anxiety level =  $7.39 \pm 2.71$ ; 69% female) had not yet passed their car driving license because of their apprehension about driving.

### 3.3.2. Main apprehended and avoided driving situations

This question was only asked to those reporting a level of driving anxiety greater than or equal to 1 that is to the respondents considered as anxious whatever the intensity of this anxiety ( $n = 3907$ ).

The three most apprehended situations were: 1) *driving in fog* ( $2.4 \pm 1.11$ ), 2) *driving while tired* ( $2.35 \pm 1.09$ ) and 3) *driving in heavy rain* ( $2.3 \pm 1.14$ ) (Table 2). The most apprehended situations are the same for men and women. Despite higher mean scores for women, the differences are not significant.

From those who reported having a driving license and who declared driving at least from time to time ( $n = 3406$ ), the three most avoided situations were: 1) *driving while tired* ( $2.05 \pm 1.15$ ), 2) *driving with a person criticizing the driving* ( $1.73 \pm 1.3$ ) and 3) *driving in fog* ( $1.71 \pm 1.18$ ). Again, the most avoided situations are the same for men and women. Despite higher mean scores for women, the differences are not significant.

## 3.4. Contributive factors of driving anxiety

### 3.4.1. Crash involvement and driving anxiety

To assess the impact of having been involved in a road crash on driving anxiety, we focused on the mean score of driving anxiety according to 4 conditions (Table 3):

- Not having been involved in a road crash,
- Having been involved in road crash(es) only without any bodily consequences,
- Having been involved in road crash(es) only with bodily consequences,
- Having been involved in road crashes with and without bodily consequences.

The mean level of driving anxiety was significantly different according to road crash experience ( $F(3,4995) = 32.32; p < .0001$ ). Post-hoc analysis revealed that people being involved only in crashes without any bodily consequence reported a lower intensity level of driving anxiety than the 3 other groups: 1) those who had never been involved in any road crash ( $p < .0001$ ), 2) those who had been involved in crashes with bodily consequences ( $p < .0001$ ), and 3) those who had been involved in several crashes with and without

**Table 3**

Proportion of persons not involved or involved in a road crash(es) and associated mean score of driving anxiety ( $\pm$  Standard Deviation).

	n (%)	Mean score of driving anxiety ( $\pm$ SD)
Not involved in any road crash	2494 (49.9)	3.3 ( $\pm 2.8$ )
Only crashes <u>without</u> any bodily consequences	1695 (33.9)	2.6 ( $\pm 2.5$ )
Only crashes <u>with</u> any bodily consequences	245 (4.9)	3.7 ( $\pm 2.9$ )
Crashes <u>without</u> and crashes <u>with</u> bodily consequences	556 (11.1)	3.5 ( $\pm 3.0$ )



bodily consequences ( $p < .0001$ ). In addition, those involved in crashes with bodily consequences reported a higher intensity level of driving anxiety than those who had never been involved in any road crash ( $p < .05$ ).

### 3.4.2. Other contributive factors

This question was only asked to those reporting a level of driving anxiety greater than or equal to 1 that is to the respondents considered as anxious whatever the intensity of this anxiety ( $n = 3907$ ) (Fig. 3).

The factor that seems to have the greatest contribution is the “*lack of confidence in other drivers’ behavior*” ( $M = 1.88 \pm 1.25$ ), followed by “*having been informed about the dangers of driving*” (via magazines, television or other) ( $M = 1.40 \pm 1.2$ ), then “*witnessed a road crash*” ( $M = 1.29 \pm 1.23$ ) and the “*lack of self-confidence*” ( $M = 1.28 \pm 1.24$ ).

Women’s scores for each of these factors are significantly higher than men’s except for “*having had a car failure in a problematic situation*”, “*knowing people with driving anxiety*”, “*witnessing a road crash*” and “*having been involved in a road crash*”. Notably, for the factor that appears to have the highest contribution, i.e. “*lack of confidence in other drivers’ behavior*”, women had a mean score of 1.50 ( $\pm 1.29$ ) and men of 1.01 ( $\pm 1.13$ ).

### 3.4.3. General anxiety

The results show a mean score of general anxiety of 9.77 ( $\pm 3.89$ ) (out of a total of 20, the minimum score being 5). This score is significantly different between men ( $8.82 \pm 3.59$ ) and women ( $10.65 \pm 3.95$ ) ( $F(1,4997) = 292.59, p < .0001$ ). Moreover, the proportion of women getting a score of 14 or over was twice that the proportion of men (24.3% vs. 12.5% respectively).

In addition, a correlation exists between the scores of general anxiety and driving anxiety (All sample:  $r = 0.470, p < .0001$ ; Men:  $r = 0.518, p < .0001$ ; Women:  $r = 0.395, p < .0001$ ).

## 4. Discussion

### 4.1. Prevalence of driving anxiety

This study is the first prevalence study about driving anxiety in France. The objective was to estimate the proportion of French people who are concerned by any level of driving anxiety and to estimate the demographical factors correlated to it.

First, the results of this survey show that nearly 80 % of our sample express at least a minimal level of driving anxiety. Driving being not a risk-free activity (Bowen et al., 2020), it may explain why the vast majority of drivers express a certain amount of anxiety about this activity. It is noteworthy to mention that anxiety may be viewed as a continuum and, in some cases, this anxiety may be a positive element (Endler and Kocovski, 2001). When it is moderate, what we have called “anxiety” can be experienced as a positive stress to maintain vigilance, a state of alertness during this activity that involves strong interactions between oneself, other users, the infrastructure, and the environment. Nevertheless, it is difficult within the context of this survey to determine a level of driving anxiety that may be considered as acceptable from an individual perspective, but also from a safety perspective. Future research should be designed to address this issue using experimental setups designed to objectively assess the driving behavior (simulator or naturalistic studies) when confronted with different levels of driving anxiety.

Here, we decided to consider that only those who rated their driving anxiety as 0 were not anxious at all about driving as in the studies by Taylor on samples of older people ( $>55$  years old) (Taylor et al., 2011, 2018). However, to be able to compare our results with those obtained by Taylor (2018) in a sample of the New-Zealand population with a similar age range (18–87 years old), the data were grouped according to their categorization: non-anxious (0 and 1), mild driving anxiety (between 2 and 4) and moderate to severe

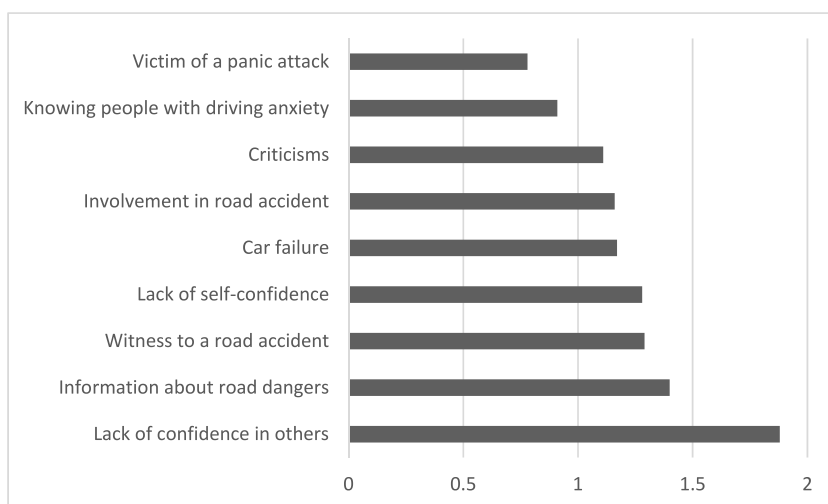


Fig. 3. Mean score for each factor that may have contributed to driving anxiety ( $n = 3907$ ) (0–4 scale).



anxiety (between 5 and 10). These data indicate that the proportion of French people with moderate to severe anxiety in our sample is twice as high as in the New Zealand sample (32.4% vs. 16%). This may reflect either cross-cultural differences or differences in the questionnaire design. Indeed, we asked the question about the intensity of driving anxiety after asking respondents to report how much they apprehended or avoided some specific driving situations. By doing this, the questionnaire makes respondents aware of their driving apprehensions before rating driving anxiety, which may lead to higher scores. However, it is more likely to increase the proportion of people with low levels of driving anxiety and not those with high levels of driving anxiety. In any case, our approach should better capture the extent of the driving anxiety spectrum. Another possible explanation may be linked to a general increase in anxiety over 2020–2021 due to the health crisis linked to the SARS-COV2 (Santabárbara et al., 2021) which may have contributed to the increase in general as well as specific anxieties.

#### 4.2. Factors influencing the level of driving anxiety

First of all, results on driving anxiety levels agree with the literature reporting higher level for women than for men (Taylor et al., 2011, 2018). Interestingly, if more men than women report low levels of anxiety (1, 2, or 3), they are less likely to report anxiety levels of 4 or higher. Note also that before 35 years old, there is no difference considering the level of driving anxiety's intensity reported by men and women. However, after 35 years old, women report a higher level of driving anxiety than men. It is noteworthy to note that these differences in the level expressed between men and women may be at least partially due to some gender stereotypes associated with driving: men are generally perceived as more skilled and self-controlled although careless than women, whereas women are generally perceived as cautious but also as having poorer driving skills and lack of self-control (Degraeve et al., 2015; Granié and Papafava, 2011). It is known that stereotypes may impact the perceived skills and the way people are prone to talk about the extent of their weaknesses according to their gender. Despite this difference in reported anxiety intensity, the main situations apprehended (fog, rain and fatigue) and avoided (fog, fatigue and passenger) are the same in men and women.

Then, results show that age is negatively correlated with the intensity of driving anxiety for both men and women. Arguably, drivers may become more and more confident with time and the acquired driving experience. Nevertheless, some drivers may fail to persist in driving altogether or may develop some avoidance strategies for some situations when driving anxiety appears in their life. For young drivers, this avoidance will then interfere with the automation of the driving tasks in general or for specific situations. For people with more driving experience, avoidance is likely to lead to a decrease in skills again, in general or for some situations. Both of these phenomena will in turn reinforce driving anxiety due to the complexity of the task. In addition, when avoidance is partial, it might lead to critical situations when individuals are unable to avoid a specific situation during their trip. With no or weak experience and a high level of anxiety, a simple rain or fog (two situations of the 3 main apprehended situations) may become highly stressful and may lead to maladaptive behaviors. These behaviors might surprise other drivers and, consequently, lead to critical situations.

People living in Paris and its surrounding area report a significantly higher level of driving anxiety than those from other French regions. This result is consistent with the fact that driving anxiety is on average higher in large urban areas. However, non-exclusive explanations may be either that people with severe driving anxiety relocate to urban areas to find some alternatives to car driving or that living in rural areas may protect against anxiety in general (Lecic-Tosevski, 2019) and so against driving-related anxiety. In addition, it is plausible that people perceived the risk of crashes as lower where traffic density is lower.

One result which needs to be pointed out is the relationship between driving anxiety and occupational life. This survey shows that people from the intermediate and low occupational categories (SPC-) report a higher level of driving anxiety than those in higher occupational categories (SPC+). This result is in line with previous French research on the prevalence of mental disorders such as anxiety disorders (the most common), mood disorders, psychotic syndromes, or alcohol or drug dependence (Cohidon et al., 2009). These authors observed that among the employed workers, the least advantaged categories, office and manual workers (partly corresponding to our SPC-) were most seriously affected.

#### 4.3. Contributive factors of driving anxiety

Not surprisingly, people who have been involved in car crashes only with injury and those who have been involved in crashes with and without injury have higher scores on driving anxiety than the others. In contrast, people who have been involved only in crashes without injury report lower driving anxiety than those who have not been involved in any crashes. This may be due to the exposition rate: the more anxious people are about driving, the less they drive and the less likely they are to be implied in a road crash. However, this hypothesis remains to be tested in future work.

Then, we studied the factors that potentially participated in the emergence of driving anxiety. In this survey, we assumed that driving anxiety may be multifactorial. Consequently, we did not ask what the main source of driving anxiety was, but to what extent different sources may have contributed to this driving anxiety. The main contributing factor reported by our sample was the lack of confidence in the other drivers. This lack of confidence may reflect a form of intolerance of uncertainty which is known to play a major role in anxiety (Khawaja and Chapman, 2007; Shihata et al., 2016). The second factor reported by our sample was having been informed about the dangers of driving through advertising campaigns. This point is in agreement with data reported by Hidalgo-Muñoz et al. (2021) and raises the question of the potential impact of the content of safety messages on triggering driving anxiety, especially in some groups who could feel vulnerable, such as older age drivers.

Finally, a positive correlation exists between the level of driving anxiety and the level of general anxiety. The mean score of general anxiety in our sample was 9.77. Although this score is lower than that reported by Zsido et al. (2020) (mean score: 11.3), we obtained a proportion of people with a score of 14 and above (potentially clinically anxious according to the authors) similar to theirs with 18.6%

(versus 20.1%). Moreover, our data are consistent with the differences between men and women on this criterion. Indeed, our data show that women have significantly higher scores and that they are twice as likely to have a score of 14 or more.

#### 4.4. Limitations and future research directions

As mentioned, driving anxiety covers a wide spectrum from apprehension for some particular driving situations to driving phobia (amaxophobia or vehophobia). If driving phobia may be quite easily identified by a clinical diagnostic, the segregation of the different non-clinical forms of driving anxiety is more difficult. The simple apprehension may be experienced as positive stress which may increase vigilance in some situations without any deleterious impact on the driving behavior. Using the 0 to 10 point-scale does not easily allow us to segregate this from more pronounced driving anxiety where negative behavioral consequences might be observed. However, the impact of these various forms on behavior and quality of life may be different and so the adapted countermeasures. Further works are necessary to fill this gap and understand the complexity of driving anxiety on the entire spectrum, and include this type of anxiety properly in the clinical guidelines to propose suitable therapies.

Indeed, in addition to determining the extent of the problem and understanding the factors that may be involved in the onset and maintenance of this anxiety, a major issue is the support of those concerned by this anxiety and for whom the impact on their daily life is significant. Several programs exist, mainly based on either virtual reality exposure treatment (Costa et al., 2018; Trappey et al., 2020) or cognitive behavioral therapy (de Jongh et al., 2011; Townend and Grant, 2006). An evaluation of these programs is out of the scope of this study. However, a better understanding of the various factors of driving anxiety is crucial to adapt these interventions to reinforce their efficiency in different populations.

Thinking further, a potential solution for people concerned with driving anxiety may come from technology. For instance, some technological solutions have been recently proposed to regulate stress in real-time while driving using different modalities: audio display (music, sounds), visual display (lights), haptics such as acupressure, odors, or other modalities such as vehicle control or ambient air changes (Béquet et al., 2020). These technologies seem promising and their efficiency could be improved by taking into account personality traits that can influence both stress response and emotional regulation (Béquet et al., 2022). Also, driving assistance, from assisted to autonomous vehicles, may be of great help to drivers who doubt on his/her driving skills. However, the main contributing factor of driving anxiety is the lack of confidence in others. Then, if I do not trust the skills of other drivers to drive safely, would I have more confidence in the abilities of an autonomous vehicle to drive safely? If I need to control the situation, would I have been able to delegate the driving task to my car without increasing my anxiety? These issues around trust in oneself, in others or in the system are also worth studying in the near future in order to be able to reduce driving anxiety through automation. Future studies should focus on the move from trust in others to trust in the system to reduce driving anxiety by the automation. This will be a challenge for car manufacturers and equipment suppliers.

The present survey provided a snapshot at a given point in time (June 2021). Thus, it is not possible to estimate with certainty how anxiety will change over time. In other words, whether our older respondents already had lower levels of anxiety in their youth than our younger respondents remains an open question. To go further, it would be interesting to study not the effect of age but the effect of the number of years after obtaining a driving license and to carry out longitudinal studies on this issue.

Knowing the extent of this phenomenon, especially in France, it would be interesting to shed light on how driving anxiety can manifest itself according to its intensity and individual characteristics. Then, to determine what impact it can have in everyday life and also, from a safety point of view, on driving skills and behavior, that is when the apprehension of some situations meets the reality of these situations, increasing the anxiety state (Endler and Kocovski, 2001; Spielberger, 1983).

## 5. Study findings and concluding remarks

This first prevalence study of driving anxiety within a French representative sample of the 18 years old and over revealed that 80% of our sample reported at least a minimal level of driving anxiety.

Results show that age is negatively correlated with the intensity of driving anxiety, suggesting that drivers gain confidence with time and the acquired driving experience. This is true for men as for women even if the latter report a higher level of driving anxiety than men older than 35 years old.

This survey also shows that the main contributing factor to driving anxiety reported by our sample was the lack of confidence in the other drivers. Although the scores of apprehension and avoidance for each of the driving situations proposed are higher for women than men, it appears that they apprehended and avoided the same driving situations.

This study confirms the contribution of gender and age on driving anxiety and brings new questions about the frontiers between positive and tolerable driving anxiety, and its potential negative outcomes. This paper also proposes new research needs to better understand better the contributing factors of driving anxiety as well as, the different profiles of the individuals concerned in order to limit its apparition and improve or develop specific interventions.

### Authors' contributions

AF contributed to design the survey and to analyze the data, interpreted the data and was the main contributor in writing the manuscript, ME contributed to design the survey, analyzed the data, BC contributed to design the survey, to interpret the data, and Writing – review & editing, CJ contributed to design the survey, to interpret the data, and Writing – review & editing, AHM contributed to design the survey, to interpret the data and Writing – review & editing.

## Funding

This work was supported by the *Délégation à la Sécurité Routière* of the French government (project n°2103095341).

## Declaration of competing interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. A.FORT.

## Data availability

Data will be made available on request.

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