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Work intensification in the road transport industry: An approach to new working scenarios with automated vehicles

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Abstract.
BACKGROUND: The deployment of automated vehicles is causing transport systems to undergo a transition period. Notwithstanding such technology advancements, the work activity in road transport remains severe in terms of working conditions, given an ever-increasing work intensification scenario.
OBJECTIVE: To analyze the drivers' point of view over factors that determine the intensification of their work, to take preventive measures for future working conditions with automated vehicles.
METHODS: A sample of 336 Portuguese professional drivers answered the Health and Work Survey.
RESULTS: Work at an intense pace (70.6%) or working beyond the assigned timetable (68.5%) were reported as conditions that may induce work intensification. The need to follow production norms/meet strict deadlines or feeling exploited at work doubles the risk of musculoskeletal disorders. Moreover, dealing with tense situations with the public, exposure to constant interruptions, and once again feeling exploited at work, are risk factors that increase, at least, four times as much the perception of generalized discouragement, anxiety, or irritability.
CONCLUSIONS: The recommendations that emerge from our findings aim at ensuring that automation does not end up becoming a new source of work intensification.

Keywords: Road transport workers, work-related risks, health problems, automated vehicles, sustainability

1. Introduction

The speeches about our contemporary society support mobility as a dominant and side-by-side value with an intrinsically positive nature [1], but scarcely do they leave room for discussion in which conditions is mobility produced as a service activity. Moreover, over the past few years the international community has made several commitments related to transport and mobility, setting the need to transform the sector

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and to ensure that the future of transport is sustainable [2, 3]. To do so, the European Commission sets as a priority a safer, cleaner and more accessible mobility system for all, taking advantage of the new possibilities provided by digital technologies and automation [4].

Given the rapid development of technology, particularly in the domain of automated driving solutions [5, 6], we are witnessing profound changes in how transport and mobility services are produced. Thus, this industry is nowadays going through a "transition" period towards the modernization of the EU mobility system. Besides the technology advancements in autonomous vehicles, there is another important dimension in achieving a modernized transport system: the social dimension [4, 7]. It is essential to ensure that the current transformations effectively address the work-related risks the professional drivers face in their daily work activity. In this sense, the implementation of digital and automated solutions in transport systems ought not to overlook the workplaces, the employment and the working conditions [8].

In the EU, the transport sector employs roughly 11 million workers. The most representative subsector is road transport (freight transport and passenger transport) - it encompasses circa five million workers [9]. Furthermore, the road transport is the main public transport in use [10].

Due to this importance, the transport industry receives huge investments in technological driving systems and vehicle automation [8, 11]. In terms of public transportation systems, the number of autonomous shuttle pilots has rapidly increased over the last few years in Europe, mainly in France, Germany, The Netherlands and Finland. Still, Switzerland is now the most advanced country, as it has implemented autonomous minibuses in their public transport systems with regular timetables [12]. In Portugal, the introduction of autonomous minibuses on public passenger transport is expected to happen in early 2020. Despite the accelerating autonomous vehicle technology, vehicles are far from being fully autonomous, i.e., where human drivers are completely out of the driving loop. Thus, the role of the human driver/worker will keep being a key component of the transport system at least in the following decades [13, 14]. Therefore, it is crucial to analyze the professional drivers' point of view over factors that determine the intensification of their work, in order to take preventive measures during this transition period.

Our paper is structured around three central issues related to the work sustainability [15, 16]: working conditions; impacts on health; and preventive measures to reduce health-impairing conditions in transport. The first one is the characterization of the working conditions that promote the accumulation of different temporal constraints and the multiplication of new pace-related demands [17–20]. The second one is the identification of the effects such exposure has on health, that is, the work-related health complaints.

Considering the human work perspective, which conditions should be taken into account when implementing automated driving solutions? Our recommendations contribute some answers in terms of working conditions and we believe they are worth looking at in the face of future transformations in work organization due to automated driving.

2. Working conditions in the EU transport: sources of work intensification

The road transport industry is frequently characterized by high levels of competitiveness between companies and by a time-related pressure due to a just-in-time management [21]. More and more, people and goods have to be taken as close as possible - as soon as possible - to their final destination. For this reason, several researchers have been focusing on work-related transport accidents, and also on the relation between the characteristics of work organization in the road transport (e.g., nonstandard and atypical work schedules; long working hours; the need to remain in the same position for a long period) and the health outcomes [22–25].

The transport industry is one of the economic activity sectors less favorable in terms of working conditions [26, 27]. According to the findings from the last European survey on working conditions [28], the job in transport in the EU implies the fulfilment of gradually more demanding norms and objectives related to a set of tasks to do in the public space (road), and with a direct interaction with the public (passengers/clients). The European transport workers stand out in items such as exposure to high levels of quantitative demands; drive with tight deadlines; exposure to irregular work schedules (rotating shifts and on-call shifts) and overtime; and exposure to disruptive interruptions.

Moreover, previous research has shown that transport workers also report the most to be undergoing adverse social behaviors related to tense situations with the public [25, 29–31], namely the exposure to verbal abuse, physical violence, and dealing with angry clients. Hence, the professional drivers report the exposure to different risk factors is increasing in their activity, particularly the demand for physical efforts and high psychological strain.

Still, both the definition and measurement of the work intensification construct poses some challenges. Working hours is one the first sources of work intensification reported most in the literature [32–34]. Even so, researchers in the field of work psychology and activity-centered ergonomics [20, 35–37] include other indicators of work intensification related to effort demands and level of pressure that workers feel during their work.

Thus, in this paper, our focus on the work intensification captures both the workload in a fixed time and the temporal constraints (e.g., time pressure) experienced to perform that work [19]. Several debates about the sources of work intensification have been guiding the speech towards a macro level of analysis, such as the companies' competitiveness, flexible working practices, or the new production methods with intense technology use [38, 39]. Over the last few years, however, more attention has been paid to the factors placed at a micro level of analysis, that is, at the level of the real work situations and the rhythm of the changes at work [18, 20, 40, 41].

The work intensification is a condition of deterioration of the working conditions, as reinforced by the last European report [28]. On the one hand, we have the visible side of this work intensification associated with the work schedule. The European Community Working Time Directive (93/104/EC) keeps the principle of "flexibility in the working time", advocating that the average working time per week for the road transport workers may last up to 60 hours, as long as, in a four-month period, the average of 48 hours per week is not exceeded. However, the work intensification is not a result of the extension of the workweek alone. In addition to the effective working time, other dimensions shall be taken into consideration by looking closely to what happens while the activity is carried out. We then have, on the other hand, the least visible side of the intensification, determined by the interaction between different on-the-job time constraints.

These different sources of intensification have an impact on health [35, 37, 42]. All these concerns taken together define the methodological challenge we propose to analyze this issue: accept the multifactor recognition of the work intensification, as well as the health problems related thereto.

3. The relationship between work and health among professional drivers

Literature shows that demanding working conditions and the nature of work organization contribute to professional drivers' health decline. A research carried out in the Netherlands [43] reported the not always reconcilable requirements that came to characterize the bus driving occupation, associated with timetable and safe driving compliance - the drivers who consider punctuality a priority are the ones who report more health problems. In Sweden [44], a longitudinal study also identified health problems arising from the drivers' working conditions, particularly as an outcome from rotating shifts or irregular working hours, ambiguous or contradicting work requirements, high demand, and the low social support from colleagues and supervisors. In Portugal [40], a study with bus drivers from public and private companies revealed that one of the most striking features of the drivers' work activity is associated with the exposure to irregular working hours, mainly in terms of extended working periods (more than 9 hours per day). Concerning health issues, by extending the number of working hours per day, the bus drivers are nearly six times more likely to report stress problems.

These aspects are referenced across various papers that discuss the drivers' work activity [22–25, 41, 45, 46]. They are stressed in qualitative studies [31, 46, 47] and also in meta-analyses [48, 49], in which three specific conditions in the road transport industry are highlighted: (i) working hours (e.g., shift irregularity; extended shift cycles; split shifts) [46, 50]; (ii) the time pressure (e.g., pressure to meet the services frequency; tight route schedules) [48]; and (iii) the conditions associated with performing the professional activity in the public space (e.g., traffic; roads quality; interaction with other road users; badly parked cars) and the risk of violence from the passengers [31, 46]. All these conditions can influence the drivers' health and well-being, both physically (cardiovascular, gastrointestinal, musculoskeletal disturbances, to name a few) and psychologically (depression or anxiety).

4. Materials and method

4.1. Participants and procedure

Our sample encompassed 336 professional drivers from the north and center of Portugal (95.5%) with the following types: 60.7% bus drivers; 22.0% taxi-cab drivers; 11.0% truck drivers; 4.5% ambulance drivers, and 1.8% drivers for waste management. Most of the participants were men, 96.7%; ranging age from 21 to 71 (M = 44.06; SD = 10.65). The seniority among professional drivers was also wide, from those who only have one year of practice to others who had been working for more than 49 years (M = 12.40; SD = 11.59). 89.6% of the participants were employed under permanent contract, with irregular shifts and work schedules (57%) and weekend work schedules (64.2%), and 33.2% working night shifts between 10pm and 7am.

The Ethics Committee of the Faculty of Psychology and Educational Sciences of the University of Porto and the different organizations involved approved the study protocol. Data were collected in several professional drivers' providers using a self-administered questionnaire, followed by the researchers' guidance. Participants received all materials consisting of the questionnaire, a covering letter explaining the purpose of the survey, and the guidelines to complete the questionnaire. All the participants gave their informed consent to participate, and we guaranteed their confidentiality and anonymity.

4.2. Measures

Inquérito Saúde e Trabalho (INSAT - Portuguese acronym of Health and Work Survey) is a self-reported questionnaire organized in different axes, that measures working conditions, health and well-being, and the relationship between them [51, 52]. In terms of psychometric properties, INSAT has a good internal consistency, in a Rasch PCM analysis, with a reliability coefficient > 0.8 [53].

Considering the main goal of the present study, only the risk factors and the health problems were used. The risk factors were: (i) workplace environment factors; (ii) toxicological risk factors; (iii) physical risk factors; (iv) psychosocial risk factors; and (v) work characteristics. All items were measured on a 6-point Likert scale ranging from 0 (not being exposed) to 6 (being exposed with high discomfort). The health problems correspond to a common list, which includes amongst others: back pain, headache, respiratory problems, musculoskeletal complains, fatigue, anxiety or irritability, and generalized discouragement. These items were measured using a dichotomous scale "yes" or "no" and if the answer is positive, participants were asked if the health problem is or is not related to the work activity.

4.3. Statistical analysis

A sample characterization was performed based on descriptive analysis to determine the central tendency parameters for scale variables and relative frequency for nominal variables. After this, and to analyze associations between risk factors and health problems, all variables were transformed in nominal variables (no – 0; yes – 1) and integrated in a bivariate logistic analysis (Enter method). The variables that showed significant associations in this approach were then integrated into a multi-factorial logistic analysis (Backward conditional method). Then, confidence intervals have been determined from the maximum likelihood estimation of coefficients and their standard errors. Statistical analysis used PASW Statistics 20.0 with the level of signifi-cance set $p < 0.05$.

5. Results

5.1. The risk factors in the transport activity

Descriptive analysis from INSAT, presented in Table 1, shows the frequency distribution of the "yes" answers to risk factors that have a significant impact on the work of professional drivers. More than half of the workers point out as workplace environment risk factors and physical risk factors being exposed to vibrations (55.2%), gases and dust (63.3%), noise (63.9%), intense heat or cold (67.0%), adopting awkward postures (55.5%) and remaining seated for a long period of time (88.9%).

The exposure to psychosocial risk factors, presented in Table 2, shows that being the transport activity a service, the drivers, especially in the case of passenger transport, are in permanent contact with the public, so they have to pay attention to what is going on both inside and outside the vehicle (e.g., give information on timetables, routes, stops or ticketing). A close look at the results reveals precisely risk factors associated with the provision of services to the public: endure the demands (88.6%); deal with situations of tension (76.9%); be exposed to the risk of verbal

Table 1
Characterization of risk factors: workplace environment and toxicological factors; physical factors

Workplace environment factors and toxicological factors	% Yes
Intense heat or cold	67.0
Noise	63.9
Dust and gases	63.3
Vibrations	55.2
Physical factors	
Forced to sit down for a long period of time	88.9
Awkward postures	55.5
Repetitive gestures	42.9
Heavy physical efforts	35.0

(58.0%) or physical (46.0%) aggression; be dependent on direct requests from the clients (58.2%); or be exposed to frequent disruptive interruptions (47.4%).

The transport activity has also an undeniable "industrial dimension" [31, 54], which implies the need to follow a set of strict norms, in particular those on the work schedule, the breaks or the time each itinerary shall last. The INSAT results highlight precisely certain conditions within this dimension: work at an intense pace (70.6%); follow production norms or meet strict deadlines (57.6%); continue working beyond the assigned timetable (68.5%); "skip" or shorten a meal or not have a break (69.8%); or a choice over the breaks (64.8%).

5.2. Health and well-being issues

Descriptive analysis from INSAT, presented in Table 3, shows the frequency distribution of the health problems related to work (provoked or aggravated). The literature shows a body of knowledge generally coherent about the most prevalent health problems among the road transport workers [29, 30, 49, 55]. At this point, the emphasis goes to the posture-related problems and to the need to remain in the driving position for a long time: back pain (58.2%), fatigue (42.8%), and musculoskeletal disorders (27.6%). In addition to these complains, INSAT data highlight a few more: anxiety or irritability (36.8%) and generalized discouragement (39.8%).

5.3. The perceived impact of the work risks on health

To analyze the association between work risk factors and health problems, a logistic regression was performed. The results are included in Table 4 (headache and back pain), Table 5 (muscular pain and anxiety or irritability) and Table 6 (fatigue and generalized discouragement).

Table 2
Characterization of psychosocial work factors

High demands and work intensity	% Yes
Intense work pace	70.6
Dependent on direct clients requests	58.2
Have to follow production norms or meet strict deadlines	57.6
Have to adapt permanently to changes in methods or instruments	43.2
Exposed to frequent disruptive interruptions	47.4
Exposed to highly demanding situations	59.0
Have to continue working beyond my assigned timetable	68.5
Have to "skip" or shorten a meal or not have a break	69.8
Lack of autonomy	
Have no freedom to decide how to do work	58.0
Cannot change the order of tasks to do	60.4
Not being able to choose the breaks	64.8
Work relations with coworkers and managers	
Not having my opinion taken into consideration	51.7
Impossible to express myself	62.8
Not having recognition by superiors	61.6
Exposed to the risk of moral harassment	54.0
Exposed to the risk of age discrimination	28.2
Employment relations with the organization	
Career progress is almost impossible	50.9
Not to have a satisfactory standard of living with remuneration	54.3
Lack the means to carry out my work	21.1
At my work there are conditions that threat my dignity	33.0
In general, I feel exploited	61.0
Emotional demands	
Have to endure the demands of the public	88.6
Deal with situations of tension in the relation with the public	76.9
Exposed to the risk of verbal aggression from the public	58.0
Exposed to the risk of physical aggression from the public	46.0
Ethical conflicts	
Have to do things I disapprove	24.8
Lack the means to do a job well done	46.8
Work characteristics	
Unpredictable work	71.9
Lonely work	53.3

Table 3
Health problems related to work

Health problems	% Yes
Back pain problems	58.2
Headache problems	38.1
Musculoskeletal disorders	27.6
Anxiety or irritability	36.8
Work-related fatigue	42.8
Generalized discouragement	39.8

Table 4
Association between work risk factors and health problems: headache and back pain (bivariate and multifactorial analysis)

	Health problems			
	Headache		Back pain	
Risk factors	OR *crude* (95% CI)	OR *adjusted* (95% CI)	OR *crude* (95% CI)	OR *adjusted* (95% CI)
Vibrations	4.403 (2.052–9.447)**	2.760 (1.635–4.658)**		
Dust or gases			0.392 (0.165–0.935)*	
Exposed to frequent disruptive interruptions	3,915 (1,711–8,958)**	2.623 (1.571–4.382)**	2.537 (1.079–5.966)*	2.188 (1.267–3.780)*
Have to "skip" or shorten a meal or not have a break			0.415 (0.186–0.929)*	
Exposed to the risk of physical aggression from the public	0.439 (0.206–0.934)*			
Deal with situations of tension in the relation with the public	2.454 (1.029–5.853)*	3.157 (1.634–6.098)**	2.515 (1.063–5.952)*	4.106 (2.258–7.467)**
Exposed to the risk of verbal aggression from the public			17.960 (4.044–79.755)**	
In general, I feel exploited			3.320 (1.259–8.754)*	1.825 (1.057–3.151)*

*$p \leq 0.05$; **$p \leq 0.001$.

Table 5
Association between work risk factors and health problems: musculoskeletal disorders and anxiety or Irritability (bivariate and multifactorial analysis)

	Health problems			
	Musculoskeletal disorders		Anxiety or Irritability	
Risk factors	OR *crude* (95% CI)	OR *adjusted* (95% CI)	OR *crude* (95% CI)	OR *adjusted* (95% CI)
Vibrations	2.759 (1.246–6.106)*		2.193 (1.017–4.726)*	
Dust or gases			0.351 (0.158–0.781)*	
Dependent on direct clients requests			2.153 (1.170–3.962)*	1.943 (1.168–3.230)*
Have to follow production norms or meet strict deadlines	2.225 (1.014–4.882)*	2.174 (1.217–3.885)*		
Not having my opinion taken into consideration	2.776 (1.252–6.158)*	2.282 (1.187–4.386)*		
Not having recognition by superiors	0.379 (0.146–0.987)*			
Impossible to express myself	0.246 (0.090–0.677)**	0.262 (0.120–0.575)**		
Exposed to the risk of physical aggression from the public	0.436 (0.207–0.921)*			
Exposed to the risk of verbal aggression from the public	4.935 (1.118–21.776)*			
In general, I feel exploited	3.274 (1.231–8.706)*	2.328 (1.085–4.997)*	5.284 (2.091–13.350)**	3.918 (2.272–6.756)**

*$p \leq 0.05$; **$p \leq 0.001$.

Table 6
Association between work risk factors and health problems: work-related fatigue and generalized discouragement (bivariate and multifactorial analysis)

	Health problems			
	Work-related fatigue		Generalized discouragement	
Risk factors	OR *crude* (95% CI)	OR *adjusted* (95% CI)	OR *crude* (95% CI)	OR *adjusted* (95% CI)
Vibrations	3.292 (1.533–7.068)*			
Exposed to frequent disruptive interruptions	3.158 (1.334–7.471)*		6.482 (2.357–17.827)**	4.369 (2.252–8.476)**
Impossible to express myself			3.410 (1.085–10.714)*	3.104 (1.336–7.216)*
Exposed to the risk of verbal aggression from the public	5.591 (1.033–30.262)*	1.357 (1.074–1.713)*	0.359 (0.137–0.941)*	
In general, I feel exploited	2.639 (1.016–6.854)*	2.431 (1.271–4.648)*	5.101 (1.676–15.519)*	4.049 (1.769–9.268)**

*$p \leq 0.05$; **$p \leq 0.001$.

The results showed that some work risk factors were significantly associated with health problems. The analysis of logistic regression results (not adjusted) shows that the following risk factors seem

Table 7
Summary of significant associations between work risk factors and health problems

Work risk factors	Health problems					
	Headache	Back pain	Musculoskeletal disorders	Anxiety or irritability	Work-related fatigue	Generalized discouragement
Vibrations	3x					
Dependent on direct clients requests				2x		
Have to follow production norms or meet strict deadlines			2x			
Exposed to frequent disruptive interruptions	3x	2x				4x
Not having my opinion taken into consideration			2x			
Impossible to express myself			< 1x			3x
Deal with situations of tension in the relation with the public	3x	4x				
Exposed to the risk of verbal aggression from the public					1x	
In general, I feel exploited		2x	2x	4x	2x	4x

to be related to headache and back pain: "vibrations"; "dust or gases"; "exposed to frequent disruptive interruptions"; "have to skip or shorten a meal or not have a break"; "exposed to the risk of physical aggression from the public"; "deal with situations of tension in the relation with the public"; "exposed to the risk of verbal aggression from the public"; and "in general I feel exploited".

From the multifactorial analysis, "deal with situations of tension in the relation with the public" (3.157; CI 1.634–6.098, 95%) and "exposed to frequent disruptive interruptions" (2.623; CI 1.571–4.382, 95%) were key factors that increased about three times the perception of headache; and four (4.106; CI 2.258–7.467, 95%) and two times (2.188; CI 1.267–3.780, 95%) the complaint of back pain.

Other risk factors also revealed important associations: "vibrations" (2.760; CI 1.635–4.658, 95%) increased near three times the perception of headache and "in general, I feel exploited" (1.825; CI 1.057–3.151, 95%) increased almost two times the perception of back pain. The same analysis was performed for two other health problems, as presented in Table 5.

The analysis of logistic regression results (not adjusted) revealed that several risk factors were considered related to musculoskeletal disorders and anxiety or irritability: "vibrations"; "dust or gases"; "dependent on direct clients requests"; "have to follow production norms or meet strict deadlines"; "not having my opinion taken into consideration"; "not having recognition by superiors"; "impossible to express myself"; "exposed to the risk of physical aggression from the public"; "exposed to the risk of verbal aggression from the public"; and "in general, I feel exploited".

From the multifactorial analysis "in general, I feel exploited" was a key factor that increased more than two times the perception of musculoskeletal disorders (2.328; CI 1.085–4.997, 95%) and almost four times the perception of anxiety or irritability (3.918; CI 2.272–6.756, 95%). Other risk factors also revealed important associations: "have to follow production norms or meet strict deadlines" (2.174; CI 1.217–3.885, 95%), "not having my opinion taken into consideration" (2.282; CI 1.187–4.386, 95%) increased more than two times the perception of musculoskeletal disorders and "dependent on direct clients' requests" (1.943; CI 1.168–3.230, 95%) increased almost two times the perception of anxiety.

Finally, the bivariate and multifactorial analysis also showed important associations with two other health problems, as presented in Table 6.

The analysis of logistic regression results (not adjusted) revealed that several risk factors were considered linked to work-related fatigue and generalized discouragement: "vibrations"; "exposed to frequent disruptive interruptions"; "impossible to express myself"; "exposed to the risk of verbal aggression from the public"; and "in general, I feel exploited".

From the multifactorial analysis, "in general, I feel exploited" was the key factor that increased more than two times the perception of work-related fatigue (2.431; CI 1.271–4.648, 95%) and more than four times the perception of generalized discouragement (4.049; CI 1.769–9.268, 95%). "Exposed to frequent disruptive interruptions" (4.369; CI 2.252–8.476, 95%), and "impossible to express myself" (3.104; CI 1.336–7.216, 95%) also revealed important associations with generalized discouragement. "Exposed to

the risk of verbal aggression from the public" (1.357; CI 1.074–1.713, 95%) revealed an association with work-related fatigue.

The overview of significant associations between work risk factors and health problems are presented in Table 7, indicating how often the exposure to work risk factors increases the probability to declare the identified health problems.

6. Conclusions

6.1. Work intensification factors and impacts on health

The transport activity encompasses a set of demanding tasks that, quite often, compel the workers to face inherently contradictory instructions: drive safely, provide a service to passengers in the public space (and manage the unexpected in this relation with the public), meet the schedule, and ensure the profitability of the transport (e.g., number of passengers; number of services completed).

According to the findings, the work intensification factors do not have the same impact. The proposal to build a score to assess the simultaneous effect of different types of variables is, for that reason, questionable [42]. This is the reason why we chose to use logistic regressions; they estimate the differentiated probability of perceived impact of the work intensification risk factors on health.

The work intensification is a source of risk and pain, both physical and psychological. The interactions between physical constraints, such as vibrations, production norms, or meeting strict deadlines, make it more likely that physical health be affected by the work activity.

The studies carried out under the scientific scope of the activity-centered ergonomics reinforce the idea that the work intensification leaves little room for the workers to build operative modes capable of better preserving their health, i.e., to develop work experience [20, 56]. In fact, in the descriptive analysis of the results (cf. Table 2), it is noticeable that more than half of the workers declares feeling "lack of autonomy" (e.g., to decide how to do work by themselves – 58.0%; to choose the breaks – 64.8%).

The accumulation of physical and psychological constraints associated with the contact with the public are an additional source of work intensification and impact on health. An example thereto are the frequent interruptions, which contribute greatly for the generalized discouragement. It may be explained by the drivers' perception of not having the time to work correctly, to make a work well done, as the interruptions cause delays and prevent the fulfilment of the service schedule established/imposed by the client. The literature also underlines how the work intensity can damage the working conditions and the performance of the activity itself: "the goals, the procedures that have to be followed, the available means, are constraints each worker has to take into consideration to optimize the activity, in order to preserve one's physical and mental health as much as possible (. . .), but the urgency worsens the effects of such constraints" [42 p201].

Another example that the study's findings make particularly noticeable is the fact that the intense work situations significantly increase the perception that one is being exploited, with an impact in almost all the health problems previously addressed, either physical or psychological (cf. Table 7). The work intensification "takes time from the individuals and takes the time of the individuals" [35 p 205]. Working under such circumstances makes it virtually impossible for the workers to make use of their own requirements, experience and unique contribution to do a work well done. Hence, we are talking about an expropriation of the time a worker needs to make use of oneself at work, with highly impactful costs for the individual health.

6.2. The future of work within automated mobility scenarios: pursuing the sustainability

This study examined the sources of work intensification and their effects on road transport drivers' perceived health, at the time the transport industry is going through a period of transition to automated vehicles. Indeed, in the EU context, the sector's prospective evolution seems to be entirely monopolized by automated mobility solutions [57]. However, could automation systems be considered the solution for work intensification, diluting drivers' health complaints? Or, on the contrary, as showed in 1995 in the automation of a rail system [58], will it pave the way to other risk factors in contexts of transport services (apparently) without workers?

Until fully autonomous vehicles become a reality, i.e., operating without human input, the role of the human driver will remain a key component of the system because so far even the highest automated

driving systems rely on a back-up human driver who takes over when the technology reaches its limits or disconnects [13]. Hence, it is crucial to analyze what does contribute to the work intensification and use that analysis to improve the drivers' working conditions, especially at this critical moment when the sector is testing new human – automation interface scenarios. Therefore, we cannot help but question how to develop at the same time mobility for all and work sustainability when the human work activity in transport seems to acquire the meaning of a "second-class component" of the driving system, or as an "adjusted variable" according to the rhythm of technological progress [59].

The approach to sustainable work involves, on the one hand, taking into account the effects of the working conditions [60]; and, on the other hand, ensuring that the development of the automated technologies goes hand-in-hand with the working population characteristics and the improvement of the working conditions.

Bearing this in mind, our findings support some recommendations in terms of working conditions and they are worth attention in the face of the expected transformations due to automation.

First, the development of automated driving should consider the current demands of this work activity in order to present solutions that assist the human worker instead of giving rise to new constraints [61]. For instance, automation is expected to contribute to the efficiency of the road transport, leading to an increase in the number of transport services and in the number of hours travelled per vehicle. Hence, it is fundamental to ensure that these prospective changes do not end up contributing to the work intensification (e.g., the exposure to extended working periods) that is already experienced by the professional drivers, as our results pointed out.

Second, the role of the driver when operating automated vehicles is one of the main challenges for both transport industry and ergonomics science. The results of our study highlight a highly demanding job, entailing increasing productions norms, conflicting tasks and strict deadlines. Therefore, in automated vehicles, where workers are expected to intervene, the human driver will guarantee a possible "double role", both as a driver and as a supervisor (of the automation system) [62]. Will these situations double the tasks and work demands that the road transport workers must deal with? If so, we will be facing one of "ironies of automation" [14, 63], because rather than relieving human driver workload and vigilance, it might actually place greater demands on the worker [61].

Third, one of the main results of our research concerns the feeling of exploitation at work reported by the workers, with impact on almost all the health problems, either physical or psychological. Performing a job under these conditions, particularly in systems characterized by human-automation interfaces, may hinder the use of work experience and give rise to a feeling of "loss of control" over the work activity whereas the technology seems to acquire the domination in the work process. This aspect in the road transport work calls our attention for the need to deploy automated vehicles through a collaborative approach between the human agent and the technical agent (automation).

Taken together, these recommendations defined from our quantitative results could help designers, transport companies, transport authorities, policy-makers, and scientific community to develop automated vehicles, considering the drivers' working conditions and the real needs that automation should meet to foster health-promoting work situations and prevent new sources of work intensification.

6.3. Study limitations

The major limitation of the study lies in the fact that our sample encompassed professional drivers from different subsectors in transport (e.g., bus drivers; truck drivers, taxicab drivers) with specific constraints in terms of working conditions. For instance, the need to perform long routes with trucks/lorries; with or without passengers/clients on board; to make manual work with loading and unloading goods to/from trucks; or helping people while transporting them (e.g., sick or older people). A quantitative methodology is consistent with this sectoral approach. However, another study limitation is that this analysis has not been complemented with a qualitative approach, which would allow the identification of the specificities of those constraints in each subsector. Lastly, even though we have organized sessions to return our results to the transport companies, it would be important to share these results with other strategic stakeholders such as trade unions and public authorities called up to intervene on the regulation of transport services, as well as on the working conditions and the occupational health of those providing these services.

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Conflict of interest

The authors have no conflict of interest to report.

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