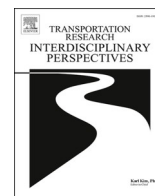


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# Transportation Research Interdisciplinary Perspectives

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## Presence of tourists and perceived safety from COVID-19 among local bus users: Evidence from a Mediterranean city

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### ABSTRACT

Since the start of COVID-19 pandemic, public transport has been signalled as a potential contagion hot-spot, leading to a generalised decrease in its use. However, public transport use is still being used and little is known about how the perception of loyal users is configured in contexts of influenza-like viruses such as SARS-CoV-2. The configuration of the perception of safety acquires a critical importance in urban contexts where the public transport system is used both by tourists and local users. The presence of strangers or higher crowding levels could impact the perception of safety among residents and their consequent travel behaviour. In the present study, we explored how the presence of tourists influences the configuration of the perception safety related to the transmission of COVID-19 on public transport of daily users. We used data from an ad-hoc survey conducted at the main bus stations and stops of the Tarragona Urban Area (Catalonia, Spain) between August and September 2020. This area includes the Costa Daurada coastal destination. The 2020 summer holiday season was characterised for the relaxation of mobility restrictions and the start of the second wave of COVID-19. Results show how the presence of tourists in buses negatively influenced the perception of safety of local users. However, this influence can be mostly explained to their prior perception of risk of contagion. These findings will be useful for policymakers and public transport managers in both the latter stages of the COVID-19 pandemic and future virus-related epidemics to maintain public transport ridership.

### Introduction

Border closures, lockdowns, physical-distancing directives, the promotion of teleworking, and the cancellation of social events are some of the measures implemented by governments worldwide since early 2020 to reduce the transmission of SARS-CoV-2 during the COVID-19 pandemic. Besides their effectiveness in reducing the spread of the novel coronavirus (Dzisi and Dei, 2020; Pradhan et al., 2020), these measures dramatically altered people's lives, with a significant repercussion on travel behaviour (Barbieri et al., 2020; Parady et al., 2020).

In Spain, as in many other countries, once the first national state of emergency and home lockdown ended, mobility levels were still low in comparison to normal circumstances. This drop in mobility was especially significant for public transport (Bucsky, 2020; Jenelius and

Cebecauer, 2020; Sahraei et al., 2021, 2020), whereas the use of active modes and private vehicles rapidly returned to pre-pandemic levels (Parker et al., 2021; Rasca et al., 2021). Although the rise in the use of active transport may be beneficial for the environment and for people's physical and mental health (Gascon et al., 2019; Mueller et al., 2015), a prolonged decline in public transport ridership may pose serious financial challenges for transportation agencies (Gutiérrez et al., 2020b), in addition to the well-known repercussions on air quality, noise levels and greenhouse emissions derived from greater automobile use (Banister, 2008; Nieuwenhuijsen and Khreis, 2016).

Much has been written about the overall changes in mobility patterns due to the pandemic. However, less is known about the factors that are driving changes in travel behaviour and, specifically, in public transport satisfaction and consequent ridership. It seems clear that, besides the

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implementation of the above-mentioned prevention measures, the fear of infection, which has been exacerbated by the lack of information and by confusing governmental messages regarding COVID-19 transmission, lies behind the drop in public transport ridership, as seen in previous epidemics such as influenza, MERS, SARS or Ebola (Hotle et al., 2020; Kim et al., 2017; Lau et al., 2003; Wang, 2014) and recent COVID-19-related literature (Neuburger and Egger, 2021). Nevertheless, public transport has continued to be utilised.

Aside from a few examples (Betkier, 2020; Dong et al., 2021; Khaddar and Fatmi, 2021; Przybyłowski et al., 2021), the perception of safety on public transport related to COVID-19 and its explanatory factors remains largely understudied. This field of research is especially relevant in tourist destinations where public transport systems are shared by residents and visitors. Crowding levels and the presence of 'strangers' are situational elements that influence the perception of public transport safety (Cozens et al., 2003; Feltes, 2003; Wallace et al., 1999) and that can be exacerbated in those urban areas with considerable numbers of visitors. However, the influence of tourists on the perception of safety on public transport and the derived satisfaction levels by frequent users remain understudied both in tourism and transport studies (Albalate and Bel, 2010; Biagi et al., 2020). This relationship acquires crucial importance in the context of COVID-19 due to the risk of contagion and its potential for influencing the perception of risk.

To our knowledge, no studies have explored the link between public transport safety perception in relation to virus contagion such as SARS-CoV-2 and the presence of tourists among local public transport users. To fill these gaps, the present study examines how urban residents' perceptions of safety related to the transmission of COVID-19 while travelling on public buses may be influenced by the presence of tourists, controlling for the effect of socioeconomic and perceptual factors. To do so, the study was set in the urban area of Tarragona (Catalonia), a medium-sized Mediterranean coastal urban area of about 410.000 inhabitants in 2020 and one of the main tourist destinations in Spain (IDESCAT, 2020). The study was based on data obtained from an ad-hoc survey conducted between August and September 2020 (N = 306) at the main bus stations and stops in the municipalities forming the study area. In the selected period, the end of the summer holiday season coincided with the start of the second wave of SARS-CoV-2 infection in Spain, making this temporal context of high relevance for the purpose of the study. The survey examined changes in mobility patterns and motivations and collected information of different dimensions of perceptions related to the risk of SARS-CoV-2 infection, together with sociodemographic profiles.

## Background

This literature review sets the study within the context of the global pandemic in which public transport has been highlighted as a source of transmission of the SARS-CoV-2 virus. Focussing on the experience of small- to medium-sized urban areas and tourist destinations, the determinants of the perception of risk and safety on public transport in the context of virus-related pandemics such as COVID-19 is reviewed. Special emphasis is placed on the role of the presence of tourists in public transport systems and its relationship to public transport safety perception related to influenza-like viruses such as COVID-19 among local users. Since the outbreak of the COVID-19 pandemic, indoor and crowded environments such as shopping malls, work and educational centres, and public transport hubs have been signalled as potential hot spots for contagion, given past evidence on influenza-like diseases (Goscé and Johansson, 2018; Zhu et al., 2012). Recent studies conducted in the early stages of the pandemic found associations between public transport use and SARS-CoV-2 infection (Buja et al., 2020; Harris, 2020), although this relationship remains inconclusive, especially with the general adoption of preventive measures such as face-coverings and hygiene strategies (Dzisi and Dei, 2020; Moreno et al., 2021; Parady

et al., 2020).

Regardless of the actual risk of infection on public transport, recent studies have widely reported a dramatic decline in ridership and a shift towards other means of transport worldwide, mostly performing their analyses at the country level (Anke et al., 2021; Barbieri et al., 2020; Beck and Hensher, 2020; Jenelius and Cebecauer, 2020) or in large metropolitan areas (Park, 2020; Sahraei et al., 2020; Shakibaei et al., 2021). There is less evidence regarding changes in mobility in small- and middle-sized urban areas or tourist destinations, except for a few case studies in Italy (Campisi et al., 2020), Poland (Przybyłowski et al., 2021) and Spain (Aloi et al., 2020; Orro et al., 2020). This is a case in point, considering that the spread of COVID-19 might have altered the travel behaviours of residents in smaller urban areas or tourist destinations differently from those in larger metropolitan areas and considering the limited supply of public transport services (mainly through bus systems) and lower overall transit ridership and crowding levels in the former.

In addition to exploring changes in travel behaviour due to COVID-19, more research is needed to determine the factors influencing these changes, especially those related to fears and perceptions. Beyond remote working or studying and mobility restrictions implemented to tackle the spread of COVID-19, the drop in public transport ridership can be mainly explained by changes in the perception of safety among its users, given the dependency of travel behaviour on the perceived control of risks (Ajzen, 1985). But what modifies the perception of risk and safety on public transport? Besides people's personalities (Carr, 2001; Thomas, 2009), shorter-term cognitive processes such as state anxiety play a major influence on the overall perception of safety. State anxiety, defined as a transitory response that leads to feelings of apprehension, dread and tension (Endler and Kocovski, 2001), influences the perception of risks (Mobbs et al., 2007) and, thereby, evaluations and personal decisions such as travel behaviour. During this pandemic, the lack of information, unclear governmental messages and statements signalling the risk of contagion by close contact with infected individuals are likely to have raised travellers' anxiety levels and altered people's perceptions of public transport safety (Neuburger and Egger, 2021; Parady et al., 2020). Sociodemographic factors such as gender, age, or income modify the perception of safety on public transport (Delbosc and Currie, 2012), with women and older people proving to be more sensitive to fear than men and younger populations (Cahyanto et al., 2016; Neuburger and Egger, 2021; Zhang et al., 2005); in addition, high-income individuals have been associated with higher levels of unsafeness perception (Kim et al., 2017; Zhang et al., 2005) in contexts of virus-related epidemics.

The level of occupancy of stations and vehicles, ventilation, in-vehicle cleanliness or maintenance levels of facilities are also regarded as powerful common situational triggers for the perception of risk and determinants of perceived safety on public transport (van Lierop et al., 2018). An inherent characteristic of public transport, understood as a form of public space, is the co-presence with strangers and the constant negotiation for private space (Hall, 1966; Mattioli, 2014). This can be seen as a positive experience by some users, who consider it an opportunity for social interaction with diverse people (Stradling et al., 2007); however, at the same time, it can trigger negative feelings among others. In this vein, evidence in psychology has shown that the limitation of personal space when travelling together with uncertainty caused by the lack of knowledge of surrounding people in the vehicles (Brantingham et al., 1991) has been associated with increased feelings of anxiety (Greenberg and Firestone, 1977; Thomas, 2009). In the context of tourist destinations, the presence of tourists in public transport systems may additionally increase the levels of occupancy of stations and vehicles and exacerbate the perception of risk among resident public transport users due to the presence of 'strange' travellers.

In fact, the presence of tourists and its effect on public transport use and satisfaction among local populations is a generally under-researched topic with the exception of a few studies (Albalate and Bel, 2010; Biagi et al., 2020; Dickinson and Robbins, 2008; Łapko, 2014). Adequate provision of public transport in tourist destinations and its

derived use by visitors helps mitigate the environmental, health-related and socioeconomic externalities of all trips generated by them in a city while improving tourism management and residents' perceptions about tourism (Miravet et al., 2021). Moreover, if not properly addressed, the additional demand pressure in the public transport system caused by the arrival of visitors may become a negative externality on local travellers by making travel and access less comfortable (Albalade and Bel, 2010). For these reasons, exploring the impact of the presence of tourists on the safety perception of residents regarding public transport acquires critical importance in the context of virus-related epidemics by resulting in an additional negative perception of tourists among locals that may discourage their use of public transport.

The influence of the recent SARS or Ebola outbreaks on air travel and holiday travel has previously been studied (Cahyanto et al., 2016; Zhang et al., 2005), and recent evidence is appearing in the context of the COVID-19 pandemic (Neuburger and Egger, 2021). Less research has explored the impact of the perceived risk of contagion on urban mobility, with the exception of a few studies about the impacts of influenza in the US (Hotle et al., 2020); MERS in Seoul, South Korea (Kim et al., 2017); and SARS in Hong Kong (Lau et al., 2003). However, to our knowledge, very few studies have explored the factors configuring perceived safety and satisfaction among public transport users during the COVID-19 pandemic (Betkier, 2020; Dong et al., 2021; Przybylowski et al., 2021) or the influence of perceived safety from COVID-19 on travel behaviour (Barbieri et al., 2021; Khaddar and Fatmi, 2021). Nonetheless, these studies were conducted during the first stages of the pandemic, in a critical period characterized by rapidly increasing contagion rates, a general lack of information and preventive population lockdowns.

This study aims to fill several research gaps. The determinants of the perception of safety in public transport are commonly understudied in transport and mobility research and even less so in the context of viral epidemics such as COVID-19. Changes in public transport ridership and their factors since the start of this pandemic have been widely reported;

however, less is known about their impact on public transport users who continued to use this service. Moreover, to the best of our knowledge, no studies have yet explored the perception of safety from COVID-19 among public transport users after the end of the lockdown period, a moment of general relief after contagion indices had dropped and other prevention measures such as masks and physical distancing were implemented. Finally, no studies have yet explored the role of visitors on the public transport safety perception of local users in relation to influenza-like viruses and even less regarding SARS-CoV-2, which is likely to be an important factor shaping local mobility patterns in tourist destinations.

## Methods

### Study context

This research was based in the urban area of Tarragona (Catalonia, Spain), located on the shore of the Mediterranean 100 km south of Barcelona. This urban area comprises 23 municipalities, accounting for more than 410.000 inhabitants (IDESCAT, 2020), and constitutes the second-largest urban metropolitan area of Catalonia (see Fig. 1). The area is characterised by a central bicephaly composed by Tarragona (136.496) and Reus (106.168 inhabitants), and the three coastal municipalities of Cambrils, Salou and Vila-seca (more than 20,000 inhabitants each). Together, this urban area constitutes the core of one of the most important Spanish tourism destinations, the *Costa Daurada*, accounting for 20 M overnight stays in regulated accommodation in 2019, representing 77% of the total hotel capacity for this region (Eurecat, 2021; Gutiérrez et al., 2020a). Tourism activity takes place mainly during the summer months. The proximity and good road connections between the aforementioned cities enable the existence of rapid public transport connections, and these connections are the most-preferred travel option around *Costa Daurada* by tourists (Miravet et al., 2021). In fact, the massive arrival of tourists during the peak

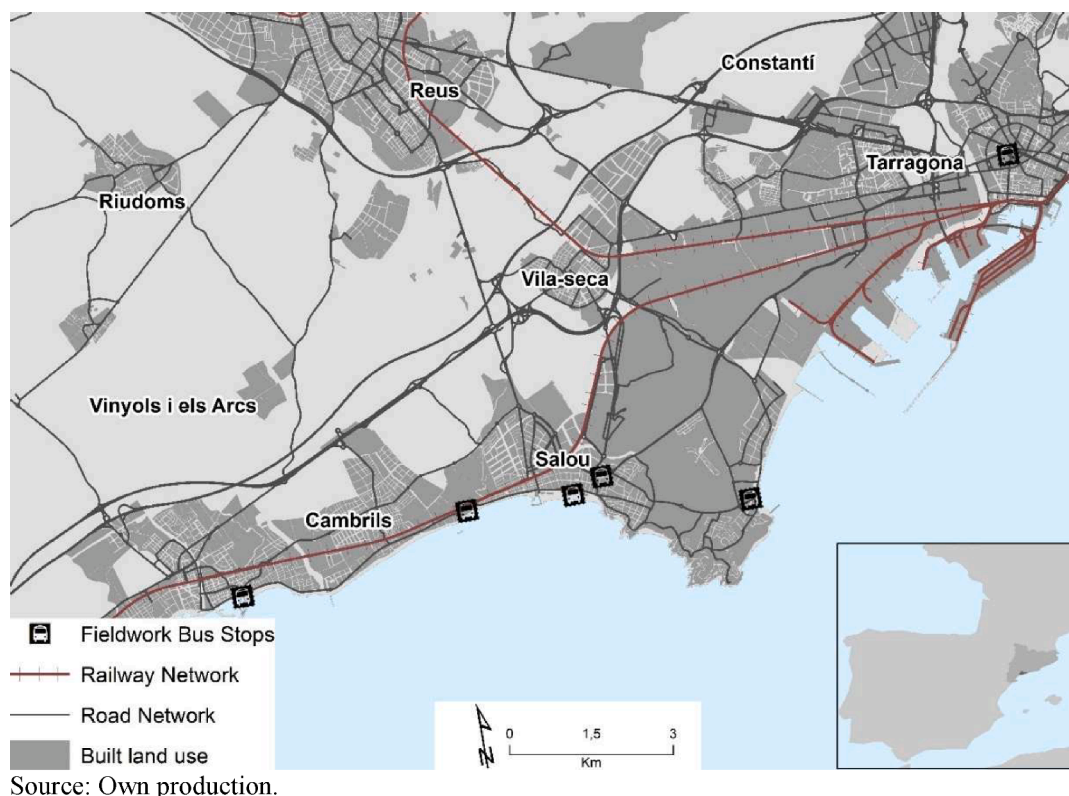


Fig. 1. Bus stops selected for fieldwork in the study area (source: own production).

tourism season means that visitors' demands for public transport services exceed those of residents (Domènech et al., 2020). In terms of transport, two train lines connect Tarragona with Reus and the three coastal towns, respectively; however, public transport in this region is mainly characterised by bus service, involving 54.9% of the trips on public transport for the region compared to 19.6% of the trips made by train (IERMB, 2007).

#### Data and methods

Data were obtained from an ad-hoc survey among public transport users conducted by the Tourism Observatory of Catalonia by Eurecat (Technology Centre of Catalonia) between 24 August and 11 September 2020. Summer 2020 coincided with a period of general relief among Spanish residents after the national stay-at-home order was lifted in May and which included freedom of mobility and tourism together with mask-wearing and physical-distancing directives. However, at the end of the season, contagion numbers were increasing again and news of a potential second wave were appearing in the media. While the accumulated incidence of COVID-19 was 27.93/100,000 inhabitants in the 14 days previous to 13 May 2020 (right after the national stay-at-home order was lifted), this increased to 149.75/100,000 inhabitants on 21 August 2020 (Gobierno de España, 2020). Moreover, it must be added that the summer 2020 holiday season for Spanish tourist destinations such as the *Costa Daurada* was unconventional due to the major decrease in the numbers of visitors (74.5%) and its origin being mainly national (Eurecat, 2021). We used an on-site survey at local bus stops to interview bus users during the pandemic. In comparison to computer-assisted telephone interviews (CATI), which are more suitable for the recruitment of all traveller profiles, on-site surveys allowed us to specifically target bus users while they were travelling. In this sense, surveyors targeted adult public transport users waiting at the main bus stations and stops across the study area, and they were randomly recruited for participation (N = 388) (see Fig. 1). Only participants who were permanent residents of the study area were selected for the analysis (N = 306) in order to obtain the perceptions of safety of local users on public transport while travelling and the influence of the presence of tourists during a holiday season. The first part of the questionnaire collected information about the changes in mobility patterns due to the COVID-19 pandemic (e.g. number of trips, distances, use of other means of transport or motivations for using public transport), while the second block of questions explored the perception regarding risk of contagion related to COVID-19: general perceived risk of contagion, perceived safety from COVID-19 when using different modes of transport, and whether the presence of tourists had altered their perceived risk of infection and, if so, how. The final part of the questionnaire collected data about the socioeconomic profiles of participants (e.g. gender, age, employment status or income).

#### Variables

The main outcome in our study refers to the *perceived safety from COVID-19 when travelling on public buses*. This variable consisted of a Likert scale with options ranging from 1 to 5 (from null to high perceived safety). The *perceived risk of contagion due to the presence of tourists on public transport* (on a scale from 1 to 3, from null to complete change) was selected as the main independent variable. As covariates, several personal characteristics were included: *gender* (men/women), *age* (continuous), *employment status* (employed/unemployed), *income level* (<1.500€; 1.500€–3.000€; ≥ 3.000€). We also included *general preoccupation with COVID-19 contagion* (low = 1 to high = 10) outside the transport domain within participants' daily lives. To test whether the risk related to the presence of tourists was specific to public transport or it responded to a general concern, we included the following to covariates: *the risk of contagion due the presence of tourists in public space* (null = 1 to complete = 3), and *the risk of contagion due the presence of tourists*

*in retail and hospitality settings* (null = 1 to complete = 3). The *motivation for the trip* (1 = work or studies; 0 = leisure or personal) and *captivity* (Yes = no private vehicle in the household or without a driving licence; No = rest) were also analysed to account for the influence of general travel behaviour and mobility constraints on the perception of safety from COVID-19 while travelling by bus.

#### Estimation strategy

We first conducted a descriptive analysis where the main outcome variable, *perceived safety from COVID-19 when travelling on public buses*, was expressed as an average and stratified by personal and perceptual factors. Then, we built four models to examine the factors associated with the outcome. First, we estimated an ordered logistic model to examine the association between the key independent variable (*the perceived risk of contagion due to the presence of tourists on public transport*) and the outcome variable (*perceived safety from COVID-19 on public transport*) while adjusting for the rest of the relevant covariates (Model 1).

Ordered logit estimation assumes the existence of an underlying non-observable variable  $y^*$ , which is the linear function of a set of covariates ( $x_j$ ) that take different values for individual  $j$ , plus an error term  $u$ .  $\beta$  is a set of coefficients to be estimated. Thus,  $y^*$  is defined as:

$$y^* = x_j\beta + u \quad (1)$$

Instead,  $y$  is observed and represents a category of response and takes a discrete ordinal value that ranges from 1 to  $K$ . Thus,  $y = 1$  if  $y^* \leq k_1$ ,  $y = 2$  if  $k_1 < y^* \leq k_2$ , ..., and  $y = K$  if  $y^* > k_{K-1}$ . The total number of categories is represented by  $K$ , while  $k$  denotes the cut points that determine that the observed category of response takes a particular value. The total number of cut points equals  $K - 1$ .

As a result, the probability that the observed outcome takes the category  $i$  can be expressed as follows:

$$\begin{aligned} Pr.(y = i) &= Pr.(k_{i-1} < x_j\beta + u \leq k_i) \\ &= \frac{1}{1 + \exp(-k_i + x_j\beta)} - \frac{1}{1 + \exp(-k_{i-1} + x_j\beta)} \quad (2). \end{aligned}$$

Besides controlling for profile variables, the *general preoccupation with COVID-19 contagion* was included to control for the influence of the overall perceived risk of contagion on perceived safety on the bus, whereas the *risk of contagion due to the presence of tourists in public spaces* and the *risk of contagion due to the presence of tourists in retail and hospitality settings* were included to detect whether the presence of tourists acted as a general risk factor or whether the presence of tourists was particularly relevant while travelling by bus. Second, we built three additional models: Model 2 included *general preoccupation with COVID-19* transformed as two dummy variables; Model 3 included an interaction term in each of them between *moderate general preoccupation with COVID-19 contagion* and residents' perceptions of the increase of the risk of contagion because of the presence of tourists on public transport; and Model 4 did the same for *high general preoccupation with COVID-19 contagion*. These interactions aim to identify possible differences in the association between the perceived risk of contagion due to the presence of tourists and the outcome, based on different overall levels of concern due to COVID-19.

All calculations and statistical analyses were performed using Stata 16 (StataCorp, 2016, College Station, Texas), software that allows the estimation of the ordered logit without the installation of an additional package.

#### Results

The final sample (N = 306) of selected participants were mostly female (55.9%), young (35.3%) or middle-aged (48.0%), employed (57.7%), with a low household income (<1.500€ = 32.0%), without access to a car in their household or a driving licence (65.0%), and they

travelled mostly for non-professional reasons (53.3%) (Table 1). Regarding the overall risk of contagion, sampled participants mostly reported a high general preoccupation with being infected with COVID-19 (53.9%). In terms of the presence of tourists, 43% of respondents declared that the presence of visitors completely altered their perceived risk of contagion in public spaces; 50.3% declared the same relative to the risk of contagion on public transport; and, similarly, 52% reported a high perceived risk of contagion due to the presence of tourists in retail and hospitality venues.

On average, participants reported a moderate level of *perceived safety from COVID-19 when travelling on public buses* (2.98 out of 5) at the time of the survey. However, significant differences were detected in the bivariate analysis when participants were stratified by personal characteristics and factors related to their perceived risk of contagion. Participants who reported a higher general preoccupation with COVID-19 contagion rated their perception of safety on public buses significantly lower (2.73) than those who were less concerned (3.78). Travellers who reported that their perceived risk of contagion would completely change due to the presence of tourists in a public space, on public transport, or in retail and hospitality settings showed a significantly lower perception of safety on public transport (2.72, 2.66 and 2.72, respectively) than those for whom the risk did not change (3.28, 3.36 and 3.33, respectively). Regarding their personal profiles, those *older than 55 years* (3.42) trusted public transport with respect to infection at a higher degree than *young* (2.82) and *middle-aged adults* (2.88). No significant differences were detected between *women* and *men*, *captive* and *non-captive*, and *employed* and *unemployed* participants either by income level or for the motivation of the trip.

In Model 1 (Table 2), we present the estimates from the first ordered logistic regression that examines the association between the perceived safety from COVID-19 on public transport and the key independent variable and relevant covariates. The key independent variable, *risk perception due to presence of tourists on public buses*, proved to be one of the two most determinant variables since, for a one-unit increase in the test score of risk perception due to the presence of tourists on public transport, the odds of high safety perception versus the combined middle and low high safety perception categories are 0.51 (CI: 0.262–0.983) times lower, given that the other variables are held constant in the model. Also, a significant negative association was found between *pre-occupation with contagion from COVID-19* and perceived safety since the odds of high safety perception on buses are 0.85 (CI: 0.784–0.918) times lower for those who are more preoccupied. By contrast, captivity showed the strongest positive influence, with those participants not having transport alternatives (being captive) increasing 1.74 (CI: 1.093–2.753) times the odds of having high safety perception on public transport versus the combined middle and low categories, compared to those having an alternative. Moreover, *age* proved to be a significant factor; for each increasing category of age, the odds of high safety perception on public transport compared to the combined middle and low categories are 1.77 (CI: 1.070–2.926) and 3.07 (CI: 1.571–6.007) times greater, respectively, showing that older participants perceived public transport as safer than younger ones (<25 years old). No significant influence was detected for *gender*, *professional status*, *motivation for the trip*, *risk of contagion due to the presence of tourists in a public space*, and *risk of contagion due to the presence of tourists in retail and hospitality settings*.

Model 2 (Table 2) showed that, when the focus is placed on *pre-occupation with contagion from COVID-19* by introducing two dummy-transformed variables for moderate and high levels of this variable, the effect of these remains significantly negative and lower odds ratio values are obtained. Models 3 and 4 (Table 2) showed the estimated results in which the same variables as in Model 2 have been included, together with an interaction between moderate and high levels of *general pre-occupation with COVID-19 contagion* (Model 3) and *risk of contagion due to the presence of tourists on public transport* (Model 4), respectively. Results demonstrated that the interaction only proved to be significant

among those participants showing a high preoccupation with COVID-19 contagion (Model 4). For a one-unit increase in the test score of risk perception due to the presence of tourists on public transport among these participants, the odds of high safety perception versus the combined middle and low high safety perception categories are 0.84 (CI: 0.677–1.033) times lower. Although a strong relationship (90% confidence level) was not shown, the effect of risk due to the presence of tourists can be related to fear of COVID-19 contagion rather than to their presence since, when the interaction is included, this becomes no longer significant, while the upper bound of the confidence interval increases beyond 1. In contrast, no significant changes were detected among those showing a moderate preoccupation with COVID-19 contagion since the presence of tourists remained significant (Model 3). *Captivity*, *age*, and an intermediate *household income* (1,501–3,000€) maintained similar significant odds across all four models, and the lower and upper bounds of the confidence intervals did not experience substantial changes.

Variance inflation indexes have been calculated to test the existence of multicollinearity issues to be addressed. According to the results of the indexes, multicollinearity needs to be addressed only in model 4.<sup>1</sup> The models presented in Table 2 have been replicated by excluding the variables 'presence of tourists in public spaces' and 'presence of tourists in retail and hospitality settings'. The variance inflation indexes for these new models signal that, once these variables are removed, multicollinearity is no longer an issue, while significance levels of the control variables remain unaltered and their odds ratios exhibit only exiguous variations, which are far from falling beyond the confidence intervals presented in Table 2.<sup>2</sup> In fact, there is only a relatively moderate increase in the odds ratio associated with the presence of tourists on public transport and its interaction with preoccupation with COVID contagion, which is absolutely logical considering the correlation with the excluded variables.

The two variables that have been removed are relevant for the specification of the model, nonetheless, as they allow disentangling whether the presence of tourists at the destination is related to the risk perception in general, or whether what is relevant is tourists using public transport services. Taking all this into consideration, no changes to the models shown in Table 2 have been introduced. Moreover, the suppression of these two variables would result in an overestimation of the impact associated with the presence of tourists on public transport, as the coefficient would be capturing part of the effect caused by the presence of tourists at the destination.

## Discussion

This study has explored the factors associated with perceived safety from COVID-19 when travelling on public buses among residents in a medium-sized tourist area during the first summer of the pandemic in Spain, a temporal context in which everyday life returned to a degree of normality following a strict national lockdown. The focus has been bus users who, for several reasons, remained loyal to this transport mode, which was hardly affected in terms of ridership due to the pandemic. Our research paid particular attention to how the presence of tourists might influence these users' perceptions of safety from COVID-19. Overall, the surveyed individuals reported moderate perceived safety from the virus (2.98 out of 5), demonstrating that public transport was mostly perceived as safe, as seen in previous studies (Bekker, 2020). The fact that survey respondents continued to use this mode of transport is likely to be behind their declared perception, since those perceiving a high risk of contagion who had an alternative means of mobility most probably shifted towards other modes of transport, as suggested by recent literature (Abdullah et al., 2021; Aloï et al., 2020; Campisi et al., 2020; Shakibaei et al., 2021). However, differences in the perception of

<sup>1</sup> Available upon request.

<sup>2</sup> Also available upon request.

**Table 1**

Sample characteristics and descriptive results of self-reported perceived safety from COVID-19 on public buses, stratified by sociodemographic profiles and factors related to the risk of COVID-19 contagion.

Variables	Categories	N	%	Mean	St. Dev.	p-value
	Total	306	100.0			
<i>Outcome</i>	Perceived safety from COVID-19 when travelling on public buses					
	<i>Low</i>	112	36,6			
	<i>Moderate</i>	89	29,1	2.98	1.32	
	<i>High</i>	105	34,3			
<i>Explanatory factors</i>	Gender					
	<i>Women</i>	171	55.9	2.92	1.37	0.308
	<i>Men</i>	135	44.1	3.07	1.25	
	Age					
	<i>&lt;= 25 y.o.</i>	108	35.3	2.82	1.24	0.023**
	<i>26–54 y.o.</i>	147	48.0	2.88	1.40	
	<i>greater than 55 y.o.</i>	51	16.7	3.42	1.21	
	Professional status					
	<i>Employed</i>	176	57.5	2.98	1.35	0.0051*
	<i>Unemployed</i>	130	42.5	2.98	1.30	
	Household income					
	<i>&lt; 1.500€</i>	122	39.9	2.91	1.36	0.229
	<i>1.500€ ≤ income &lt; 3.000€</i>	135	44.1	3.12	1.30	
	<i>≥ 3.000€</i>	49	16.0	2.80	1.24	
	Captivity					
	<i>No</i>	107	35.0	2.85	1.34	0.193
	<i>Yes</i>	199	65.0	3.06	1.30	
	Motivation for trip					
	<i>Work or studies</i>	143	46.7	2.97	1.36	0.935
	<i>Leisure or personal</i>	163	53.3	2.98	1.28	
	General preoccupation with COVID-19 contagion					
	<i>Low</i>	45	14.7	3.78	1.30	0.001***
	<i>Moderate</i>	96	31.4	3.05	1.29	
	<i>High</i>	165	53.9	2.73	1.25	
	Risk due to the presence of tourists in a public space					
	<i>Low</i>	108	35.3	3.28	1.30	0.013**
	<i>Moderate</i>	64	20.9	3.05	1.21	
	<i>High</i>	134	43.8	2.72	1.33	
	Risk due to the presence of tourists in retail and hospitality locations					
	<i>Low</i>	97	31.7	3.33	1.329	0.028**
	<i>Moderate</i>	50	16.3	3.14	1.21	
	<i>High</i>	159	52.0	2.72	1.29	
	Risk due to the presence of tourists on public transport					
	<i>Low</i>	100	32.7	3.36	1.35	0.002*
	<i>Moderate</i>	52	17.0	3.21	1.18	
	<i>High</i>	154	50.3	2.66	1.27	

Note: Significant p-value obtained from Kruskal–Wallis non-parametric one-way Analysis of Variance (ANOVA) for variables with more than two categories or Wilcoxon Rank Sum Test for variables with two categories: \* Significant p-value at 90% confidence level; \*\*Significant p-value at 95% confidence level; \*\*\*Significant p-value at 99% confidence level.

safety from COVID-19 were still detected among surveyed bus users who continued to use this transport mode.

Among the different factors nuancing the perception of safety of public transport in relation to COVID-19 transmission, perceptual factors have proven to be strong determinants. As expected, preoccupation with contagion of this virus proved to be a significant determinant of perceived safety while on the bus, showing a negative association (OR = 0.848). This perception, which could also be regarded as an indicator of travellers' anxiety levels, is in line with previous studies highlighting that such a psychological condition is key in the configuration of the virus-related safety perception of public transport (Dong et al., 2021). Regarding the impact of the presence of tourists, our results suggest that a higher preoccupation with the presence of tourists on public transport in relation to virus transmission is associated with a higher perception of risk and lower safety perception of public transport (OR = 0.507), after controlling for the influence of tourists in other locations such as retail and hospitality settings (OR = 1.308) or public spaces (OR = 1.009). Although tourism has been linked to a higher perception of risk transmission of COVID-19 (Neuburger and Egger, 2021), to our knowledge, no studies have explored the link between public transport safety perception in relation to virus contagion and the presence of tourists. However, the results of the present study confirm previous research linking the presence of strangers and passenger crowding in vehicles and stations with a lower safety perception and reduced public transport satisfaction (Carreira et al., 2014; Cozens et al., 2003; van Lierop et al., 2018). In a context of normality, the presence of tourists on public transport increases the perception of crowdedness and reduces residents' satisfaction with this public service (Albalade and Bel, 2010; Biagi et al., 2020), which, in turn, can be exacerbated in the context of a global pandemic, considering the higher anxiety levels among the population.

Captivity proved to have a strong and significant influence on perceived safety from COVID-19 while travelling by bus and could

explain the significant influence of other factors such as age and income. In the present study, captive participants (those without access to a private vehicle in their household or without a driver's licence) showed a higher perceived safety from contracting the virus than those who were not captive users. As seen in previous studies, a higher frequency of public transport use, as happens among captive users, could explain the higher safety perception (Lynch and Atkins, 1988) also in the context of the COVID-19 pandemic (Neuburger and Egger, 2021), and that those fearful users who had alternative transport had already shifted to this other means. Nevertheless, more research is needed in this line since previous studies have indicated that this relationship could also work in the opposite direction, with safety perception also explaining the frequency of use of public transport, while other studies did not find a significant association between these two factors (Currie et al., 2013; Delbosc and Currie, 2012; Lynch and Atkins, 1988). Finally, older participants showed a higher perceived safety from COVID-19 on public transport compared to younger participants (OR = 3.072) as seen in recent COVID-19-related holiday travel studies (Neuburger and Egger, 2021). This positive association between age and safety perception may be explained by the fact that most older participants are still working, which implies a higher frequency of use of bus service than younger participants (as many of them are students), who would use it more sporadically, especially during summer. Thus, this result would be consistent with the safety perception provided by more frequent use of public transportation services. Another possible explanation for the lower confidence in public transport among younger participants could be their higher access to all sorts of information about the spread of COVID-19, for example, via social media (Gupta et al., 2020; Yu et al., 2020), which could lead to a reduction in the psychological distance and state anxiety levels and to an increase in their perception of risk (Bawden and Robinson, 2009) and lower confidence in public services and governments (Christensen and Laegreid, 2005; Kim, 2010).

**Table 2**

Odds ratios of the adjusted associations between perceived safety from COVID-19 on public buses and the selected explanatory factors from the ordered logistic regression, including three interaction terms (N = 306).

	<b>Model 1: Without interactions a)</b>	<b>Model 2: Without interactions b)</b>	<b>Model 3: Interaction 1</b>		<b>Model 4: Interaction 2</b>			
	Odds Ratio	CI (Low; High)	Odds Ratio	CI (Low; High)	Odds Ratio	CI (Low; High)	Odds Ratio	CI (Low; High)
Male (Ref. Female)	1.406	(0.925; 2.138)	1.414	(0.93; 2.149)	1.387	(0.911; 2.111)	1.368	(0.898; 2.084)
25-54 years-old (Ref. <25 years-old)	1.770**	(1.070; 2.926)	1.688**	(1.019; 2.795)	1.714**	(1.033; 2.842)	1.767**	(1.063; 2.939)
>=55 years-old (Ref. <25 years-old)	3.072***	(1.571; 6.007)	2.959***	(1.504; 5.823)	2.892***	(1.465; 5.712)	2.960***	(1.497; 5.854)
Professional status (Ref. Unemployed)	0.967	(0.588; 1.591)	1.009	(0.613; 1.661)	1.010	(0.613; 1.664)	0.983	(0.596; 1.622)
1.500€ - 3.000€ (Ref. <1,500€)	1.707**	(1.078; 2.701)	1.801**	(1.135; 2.859)	1.767**	(1.112; 2.808)	1.758**	(1.106; 2.796)
≥ 3.000€ (Ref. <1500€)	1.262	(0.668; 2.386)	1.291	(0.684; 2.44)	1.291	(0.683; 2.437)	1.318	(0.698; 2.489)
Captive (Ref. Non-captive)	1.735**	(1.093; 2.753)	1.696**	(1.063; 2.704)	1.709**	(1.070; 2.730)	1.718**	(1.075; 2.747)
Professional trip (Ref. Leisure)	1.131	(0.701; 1.827)	1.108	(0.685; 1.791)	1.112	(0.688; 1.798)	1.125	(0.696; 1.818)
Presence of tourists in retail and hospitality (scale 1-5)	1.308	(0.674; 2.536)	1.338	(0.689; 2.599)	1.403	(0.717; 2.745)	1.786	(0.854; 3.736)
Presence of tourists in public space (scale 1-5)	1.009	(0.633; 1.608)	1.007	(0.632; 1.605)	0.999	(0.627; 1.592)	1.019	(0.639; 1.625)
Presence of tourists on public transport (scale 1-5)	0.507**	(0.262; 0.983)	0.514**	(0.265; 0.995)	0.494**	(0.254; 0.960)	0.582	(0.298; 1.137)
Preoccupation for COVID-19 contagion (scale 1-10)	0.848***	(0.784; 0.918)						
Moderate COVID-19 preoccupation (Ref. Rest)			0.228***	(0.115; 0.454)	0.23***	(0.116; 0.458)	0.230***	(0.116; 0.459)
High COVID-19 preoccupation. (Ref. Rest)			0.373***	(0.191; 0.729)	0.385***	(0.197; 0.754)	0.386***	(0.197; 0.755)
<b>Interaction 1 = Moderate preoccupation * Presence of tourists on public transport</b>					1.079	(0.904; 1.287)		
<b>Interaction 2 = High preoccupation * Presence of tourists on public transport</b>							0.836*	(0.677; 1.033)
<b>Global significance test</b>	LR $\chi^2=50.0$	p value=0.00	LR $\chi^2=51.1$	p value=0.00	LR $\chi^2=51.9$	p value=0.00	LR $\chi^2=54.1$	p value=0.00
<b>Goodness of fit</b>	AIC=948.5	BIC=1008.1	AIC=949.0	BIC=1012.3	AIC=946.8	BIC= 1013.8	AIC=944.8	BIC= 1011.7
	McFadden=0.052		McFadden=0.053		McFadden =0.054		McFadden =0.056	
	Cox - Snell=0.151		Cox - Snell=0.154		Cox - Snell=0.157		Cox - Snell=0.162	
	McKelvey & Zavoina=0.152		McKelvey & Zavoina=0.155		McKelvey & Zavoina=0.158		McKelvey & Zavoina=0.165	

\* Significant p-value at 90% confidence level; \*\*Significant p-value at 95% confidence level; \*\*\*Significant p-value at 99% confidence level.

To summarize, this model proves that fear of becoming infected with COVID-19 negatively influences a moderate perception of safety while travelling by bus, confirming the scarce, recent related research (Dong et al., 2021). As studies on the perception of tourism during the pandemic (Neuburger and Egger, 2021) or previous evidence of public transport safety and crowding (Carreira et al., 2014; Cozens et al., 2003; van Lierop et al., 2018) have indicated that the presence of tourists on buses increases the perception of risk of infection while travelling among local residents. However, this happens mostly among those who are already very preoccupied with the possibility of becoming infected. By contrast, the frequency of bus ridership and older ages of riders could explain a higher safety perception (Lynch and Atkins, 1988), as also seen in the context of the COVID-19 pandemic (Neuburger and Egger, 2021).

**Conclusions**

This study adds to the scant but increasing evidence about the configuration of the perception of safety among public transport users

during the COVID-19 pandemic. Our main contribution is to place the focus on a specific profile of daily travellers who continued to use bus transport, besides the worldwide decline in ridership in the use of public transport, at a moment in which their everyday lives were returning to some degree of normality after months of experiencing a strict lockdown. More importantly, to our knowledge, this is the first study to explore the influence of the presence of tourists on riders' safety perceptions, a key factor in the configuration of safety perception in urban areas where public transport is shared between residents and visitors. To that end, public bus users (N = 306) in the Tarragona urban area during the first summer after the outbreak of this pandemic (August and September 2020) were surveyed.

Although surveyed participants declared that they were highly preoccupied with the possibility of contagion of SARS-CoV-2, their perceived risk of infection while travelling by bus was only moderate, thereby demonstrating a generalised trust in this mode of transport. This was confirmed especially among those users associated with higher confidence in public services since users without transport alternatives

and those who were older expressed higher confidence in the bus service in relation to COVID-19 transmission. Regarding the role of tourists in their configuration of safety perception, participants reported being highly influenced by their presence. However, this influence proved to be limited to travellers who were already highly preoccupied with the potential for contagion.

This study is not without limitations. First, the relatively small sample limits the generalisability of the results and may influence the relationships between variables. Second, the fact that most tourists visiting the study area during summer 2020 were nationals could have nuanced the perception of safety among bus users in comparison to a conventional holiday season. Nonetheless, the presence of tourists proved to be significantly associated with residents' perceptions, which is likely to be more evident in future vacation periods when tourist flows are expected to recover and the presence of foreign visitors is likely to increase significantly. Moreover, this may enhance the negative effects of tourism among residents.

For this reason, further research examining the factors determining public transport safety perception related to infection with SARS-CoV-2 are needed, which in turn could also be useful for other influenza-like viruses. Moreover, future studies should explore the role of preventive measures such as physical-distancing or mask-wearing on the configuration of this perception. In this vein, given the specificity of the approach used in this study, our findings help narrow a research gap and set a direction for future studies exploring the relationship between tourists and the perception of safety of resident public transport users in the context of a pandemic. To provide the population and governments with contrasted scientific evidence, more research is also needed that explores the causal relationship between airborne transmission of COVID-19 and public transport use. Particular focus should be placed on the role played by confusing governmental messages and the type of available information regarding the pandemic available and their effects on the configuration of safety perception among daily travellers.

Finally, the evidence presented in this work will be useful to policymakers and transport managers in tourist destinations for understanding the relationship between the presence of tourists and the perception of safety by the resident population in future stages of the current pandemic. These stages imply the addition of new influencing factors of safety perception such as COVID-19 variants or higher rates of vaccination together with the opening of national borders worldwide that will represent the arrival of more visitors at tourist destinations. In the present context in which public transport has hardly been hit in terms of ridership and loyalty, it will be necessary to monitor how all these elements impact perceptions and the derived mobility patterns of both regular users and visitors. This is particularly difficult due to prior messages stigmatising public transport. In this vein, the broadcasting of contrasting information related to public transport safety and the correct application of strict preventive measures in contexts of virus outbreaks will become key to guaranteeing the economic sustainability of public transport and to reducing the environmental, health-related, and socioeconomic impacts of transport as well as the negative perceptions about tourism among residents in tourist destinations. In terms of specific public policy, the first step implies the implementation of effective safety measures, such as the generalisation of contactless validation and payment systems and air renovation and filtering systems. Successful communication campaigns that effectively convey the safety improvements to all potential users are the second step and are also imperative. In fact, the evidence provided by the present study signals that regular users are less worried about COVID-19, as they have repeatedly made use of public transport without pernicious effects on their health. Conversely, those who have exchanged public transport for other, 'safer' alternatives and those who have been non-users all along will not rely on the efforts undertaken until effective campaigns oriented to them are designed. Moreover, the idea that the arrival of visitors is associated with a higher risk of contagion is difficult to counteract since, in fact, peoples' mobility is the vehicle that the virus uses to spread. On top of

that, negative feelings triggered by a lack of knowledge about the surrounding people on transport vehicles (Brantingham et al., 1991) are likely to swell with the presence of visitors on board. For this reason, a twofold message must be transmitted to the general public: first, risk is effectively reduced when proper actions and behaviours are implemented, and second, such measures have been implemented. Finally, public authorities should endeavour to send this message to those segments of the population who report higher levels of risk perception as they are the ones who are more concerned about the presence of tourists on public transport. These higher perceptions of risk could be underlying higher anxiety levels, although this latter point requires further analysis in future research.

#### *CRediT authorship contribution statement*

**Guillem Vich:** Conceptualization, Writing – original draft, Writing – review & editing. **Aaron Gutiérrez:** Conceptualization, Data curation, Writing – review & editing, Project administration, Funding acquisition, Supervision. **Xavier Delclòs-Alió:** Writing – review & editing. **Josep Tomàs-Porres:** Methodology, Writing – review & editing. **Daniel Miravet:** Methodology, Writing – review & editing, Writing – review & editing.

#### **Declaration of Competing Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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