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Healthy but risky: A descriptive study on cyclists' encouraging and discouraging factors for using bicycles, habits and safety outcomes

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ABSTRACT

Transportation is a necessary process that requires not only adequate means, but also individual choices. And apparently, the recent *boom* of alternative modes of transportation has substantially changed people's perceptions of cycling, as well as the reasons why they decide to use a bike. Nevertheless, people identify some motives that encourage this use together with the perceived risks and the discouraging factors which affect the choice of using a bike, thus making it important to explore all these elements in the light of the empirical evidence. The objective of this study was to explore and describe the encouraging and discouraging reasons behind the use of bikes among cyclists, together with the reasons behind their journeys and the relationship of these elements with their crash history. For this study, 1064 cyclists were asked to complete an electronic survey which gathered information on their cycling-related habits, perceptions and motives. The results show that physical health and fitness (38%), contribution to environmental sustainability (14%), economy (13%) and time saving (10%) were the most frequent factors which encouraged cycling. On the other hand, perceived crash risk (17%), adverse weather conditions (17%) and lack of safety (16%) were found to be the most relevant discouraging factors. Finally, participants who cycled with more regularity were found to be less prone to suffer cycling crashes. The findings of this study support that cycling is a choice based on both benefits and risks, and its perceived connection to health is highly prevalent among active cyclists. Furthermore, perceived risks which may discourage cycling are an issue that needs to be addressed by transport policies, in order to enhance the engagement of the population in this mode of transportation. Also, this study highlights the need to strengthen utility cycling (cycling for transport to and from places) as a way to integrate transportation within healthier practices and habits.

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1. Introduction

A progressive reduction in the use of motorized vehicles and the promotion of more sustainable, alternative transport means are, nowadays, an important part of most of the policies related to transportation worldwide (European Commission, 2014; Lois, Moriano, & Rondinella, 2015). These important changes in the dynamics of transportation will not only contribute to generate environmental improvements (e.g. better air quality, less congestion, more efficient transport), but also to enhance a positive interaction among road users, together with more favorable practices which support their health and well-being (Karanikola, Panagopoulos, Tampakis, & Tsantopoulos, 2018; Pucher & Buehler, 2017). In order to achieve these goals, diverse strategies for increasing cycling have been implemented, achieving, in most cases, a substantial growth in the number of bicycle users (Yang et al., 2010; Stewart, Anokye, & Pokhrel, 2015).

In short, cycling is one of the new emergent and alternative modes of transportation that may combine both traveling and physical activity in the most attractive way, in addition to ensuring the coverage of longer distances (if compared to the distances that can be covered on foot) (Moudon et al., 2005). Also, the progressive adoption of cycling for both transportation and recreation purposes has been strengthened through strategies such as more and better bike-sharing systems, infrastructural advances and different incentives aimed at shifting to green transportation modes (Caulfield, 2014; Zhou, 2015). However, and since the beliefs of road users about the advantages or disadvantages of certain transport modes may influence the consequent adoption or avoidance of them, it is extremely important to study the reasons behind the decision of cycling (or not), for both understanding and at the same time promoting this potential decision among the public (Acheampong, 2017; Heesch & Sahlqvist, 2013).

1.1. The growth of urban cycling: a cost-benefit matter?

The observation of how changes in attitudes, perceptions, perceived risks and benefits may strengthen the effectiveness of transport policies is fascinating; and cycling has particularly been associated with different user-related potentialities, such as: for what concerns *health*, a substantial reduction in the risk of cardiovascular disease, type II diabetes, cancer and different chronic conditions, as well as a longer life expectancy among regular cyclists (Yang et al., 2010; Fishman, Schepers & Kamphuis, 2015; Oja et al., 2011). Finally, and specifically compared to motor-vehicle drivers, commuting cyclists tend to live longer and to have a healthier Body Mass Index (BMI) (Andersen, 2017; Dons et al., 2018).

As for economics, cycling represents a major reduction in the costs of transportation for users, and it also implies large macro-economic benefits for countries (Fishman, Schepers & Kamphuis, 2015). Furthermore, cycling may significantly decrease the length of short and mid-long trips, the overall traffic congestion and the difficulties of parking bigger vehicles (Acheampong, 2017; Moudon et al., 2005). Finally, cycling enhances the integration of bicycle users into a cycling culture (based on road safety principles) and in potentially friendlier interactions with other road users (Heesch & Sahlqvist, 2013; Yang et al., 2010).

But there is another aspect of the situation that we should consider: cycling involves a series of risks and potential impairments that users may have to face, which undoubtedly influence their decision about the election of transport modes. Int Panis (2011) described crash risk as an undisputable concern for cyclists, that may influence their intention to use this means of transport. Also, some "side effects" related to the environmental sphere have been stated by De Hartog, Boogaard, Nijland, and Hoek (2010); in this sense, the prolonged exposure to factors such as air pollution and high traffic accident rates (especially in less adapted cycling roads) may constitute a potential health risk for cyclists. Finally, Winters et al. (2012) found that the decision to cycle is substantially affected by the perceptions of safety that cyclists have, which raises the need of strengthening those elements related to safety, culture and interactions with other road users through educational programs and public policies. Transport policies, however, have focused not only on increasing the quantity and quality of positive factors and benefits related to cycling, but also on generating strategies aimed at reducing the prevalence of its disadvantages and potentially discouraging factors, in order to keep a systematic and sustainable growth both in cycling and other alternative transport modes (Caulfield, 2014; Goodman, Sahlqvist, & Ogilvie, 2013; Stewart et al., 2015).

To mention an interesting fact about current cycling trends in urban areas, in 2003 the NHTSA found that cycling is a very common activity among Americans older than 16, with approximately 1 out of 4 who used the bicycle at least once per month. However, their main purpose in using the bike was recreation (i.e. a *non-utilitarian* reason), being the *utility* or *utilitarian cycling* (when the bike is used as a means of transport, rather than for sport or leisure) a very rare practice. In this regard, cycling remains constantly attached to recreational or exercise-related activities, and it is still a notably subutilized transport mode in metropolitan areas, although all its potentialities and benefits are already manifest for most of the population (Moudon et al., 2005).

1.2. "Planning the trip": some key factors influencing the decision of cycling

In addition to what has been stated in the previous paragraph, the decision of cycling, especially if we decide to integrate it in our daily journeys, requires some planning; it may also imply that the user develops a cognitive assessment prior to making this decision (Lois et al., 2015). Different researches have framed this process in the light of the Theory of Planned Behavior (TPB), which predicts the individual's behavior in relation to the behavioral intention (Ajzen, 1991; Forward, 2014). This theory is rooted in social psychology and, in the case of road users, it involves different factors such as benefits, risks and

-symbolically- the identity acquired as a cyclist, all this being part of the reasons influencing the intention to use a specific type of transport (Fielding, McDonald, & Louis, 2008).

There are some variables that play important roles in the decision to cycle instead of using other types of transport means (Fernández-Heredia, Monzón, & Jara-Díaz, 2014): demographic characteristics of users (e.g. age, gender, economic status, occupation), that can also be related to their transport habits and their closeness to cycling culture (Emond & Handy, 2012); trip-related factors linked to the length, purpose and convenience of cycling (Acheampong, 2017; Lois et al., 2015); environmental factors, that may modulate the use of bicycles (e.g. if the weather is constantly rainy, it is expected that the user will cycle less) (Dill & Voros, 2007); structural factors, related to the adaptation of the infrastructure and whether it can provide easy and safe trips for cyclists (Mulvaney et al., 2015; Reynolds, Harris, Teschke, Cripton, & Winters, 2009); and subjective reasons, in which risk perception and health-related practices may play a crucial role in choosing the bike as a means of transportation (Fernández-Heredia et al., 2014).

1.3. Objectives of the study

The objective of this study was to examine the key encouraging and discouraging factors perceived by cyclists in the use of this alternative means of transportation. As a second study purpose, this research aimed at describing the relationship between the actual (real) reasons of cyclist for engaging in their journeys and the cycling crashes suffered by them during the last 5 years.

2. Methods and materials

2.1. Sample

The present data was collected from a full sample of 1064 urban bike users from 20 different countries in Latin America (831 participants, representing 78.1% of the sample; 38.6% females and 61.4% males), Europe (161 participants, representing

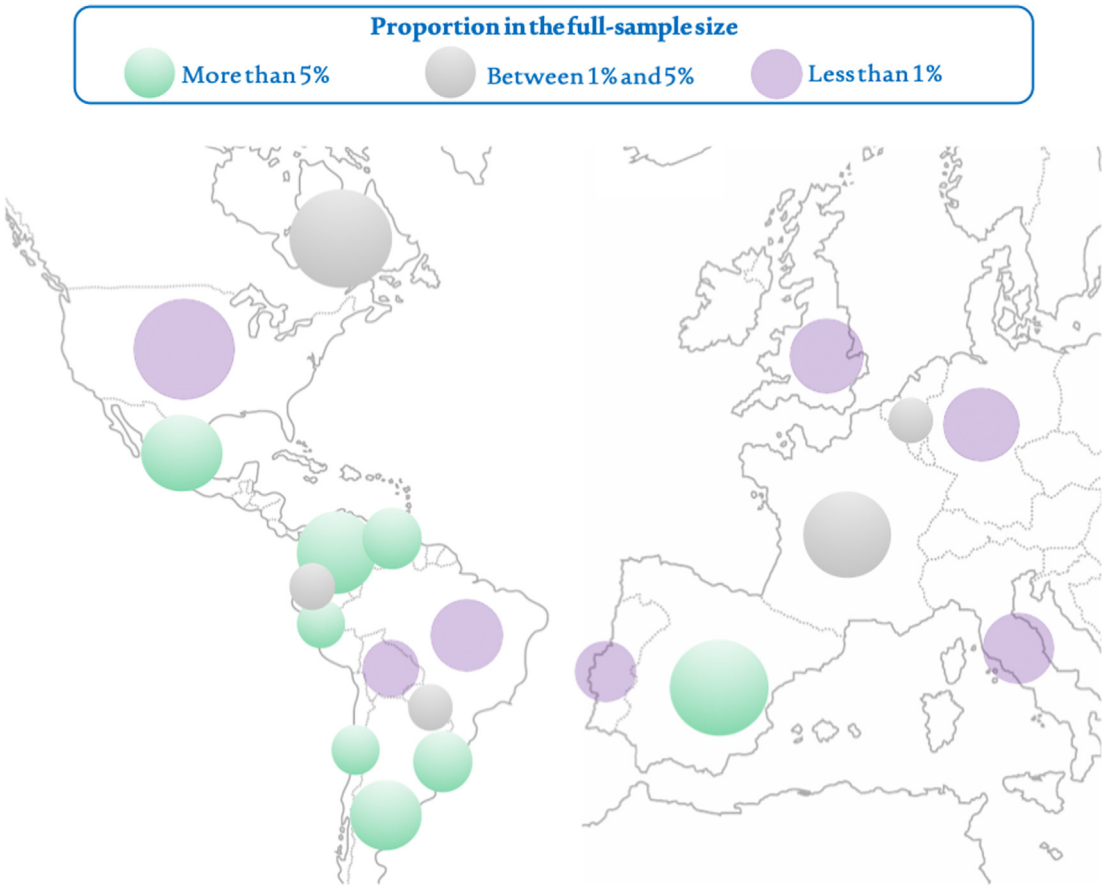

Fig. 1. Countries of provenance of the cyclists participating in the study.

15.15% of the sample; 41% female cyclists and 59% males), and North America (72 participants, representing 6.75% of the sample; 37.5% females and 61.1% males). Further details on the geographical distribution of the sample are available in Fig. 1.

Overall, the full sample was composed of 413 (38.8%) females, and 651 (61.2%) males, aged between 17 and 80, with a mean age of $M = 32.83$ ($M = 31.92$ females; $M = 33.42$ males) years. Half of the respondents (50.1%) had an undergraduate degree, and 29.9% a post-graduate degree. 9.1% of them had received a technical training (more advanced than a high school diploma, but lower than a university degree); 10.4% only had a high school diploma, and the remaining 0.5% had a maximum educational level of primary studies.

2.2. Study design and procedure

For this cross-sectional and exploratory study, participants completed an on-line questionnaire, sent through an electronic-based invitation for each potential participant. A convenience (and *non-probabilistic*) sampling was used, based on the accessibility to the study population, and on their disposition to take part in the research. This sampling technique was chosen considering that it is fast, economically reasonable and adaptable to the participants' schedule (Tyrer & Heyman, 2016). First, subjects were invited to get involved in the research through a verified inter-institutional mailing list shared among some universities. The list included students, staff members and individuals who had participated in previous researches, who had therefore previously accepted to be incorporated in the database for further participation in other studies. The survey was applied guaranteeing the anonymity of the participants and emphasizing the fact that the data would only be used for research purposes. An informed consent statement was checked and accepted by participants as a requirement for their voluntary participation in the survey. The importance of answering honestly to all the questions was emphasized, as well as the non-existence of wrong or right answers. Surveys were fully completed by 1064 cyclists, discarding incomplete or partially completed questionnaires. The response rate was approximately 42.6%, bearing in mind that approximately ±2500 questionnaires were initially delivered.

2.3. Description of the questionnaire

For this research, a semi-structured questionnaire was administrated in Spanish. It consisted of two main sections:

The first part of the instrument asked about individual and demographic variables, such as age, gender, and current main occupation, and it contained a brief set of questions on cycling habits, including the number of trips per week and their average length. Also, at the end of this section, and after reminding participants about the anonymity of the study, participants were asked if they had (or not) suffered cycling crashes/accidents during the previous 5 years, and how many -regardless of their severity but specifying that they were non-fatal crashes-. Thus, the *traffic crash rate* was understood for this study as "the total amount of traffic crashes (collisions with vehicles, objects, obstacles and road users) suffered while cycling during the last 5 years".

As for the second part of the survey, participants were asked to: *a)* provide up to three reasons or motives that encouraged them to use the bicycle as a transport mode, being the first the most important and the third the less relevant, and *b)* provide up to three reasons that discouraged, in their perspective, the use of bikes as a transport mode, using the same hierarchy than in the previous question.

2.4. Ethics

To carry out this study, the Research Ethics Committee of the University of Valencia was consulted, certifying that the research subject to analysis responded to the general ethical principles, currently relevant to research in Social Sciences, and also certifying its accordance with the Declaration of Helsinki, thus issuing a favorable opinion (IRB approval number H1517828884105). Furthermore, a statement of informed consent containing ethical principles and details of data treatment was used for all participants, explaining the objective of the study, the mean duration of the survey, and the voluntary nature of participation, and it was provided to them before they answered the questionnaire. Personal and/or confidential data were not used, being this an anonymous research, implying no potential risks for the integrity of the respondents.

2.5. Data processing

For the first part of this study, the raw database was checked and transformed into numerical or categorical data, and study variables were built up. Although only few questionnaires contained missing data and the sample was extensive, missing values were recoded. Once the database was revised, basic descriptive analyses were performed in order to characterize the sample in terms of demographic and cycling data. Also, frequency analyses were carried out for describing the participants' reasons to use the bike in their trips. Finally, Chi-square independence tests (with differential significance level criteria for $p < 0.05$, $p < 0.01$, and $p < 0.001$) were performed to determine significant trends between trip reasons and the fact of having (or not) suffered at least one cycling crash in the last 5 years.

As for qualitative information, categorical-based analyses were performed in order to filter and group the encouraging and discouraging reasons provided by the sample of participants regarding the use of bicycles. A total of 13 categories were created for the encouraging reasons, and 15 for the discouraging ones, both of them including one supplementary category,

i.e., *other*, in case of less represented responses. Once categorized, the responses were exported and coded as qualitative data, based on their frequency-based analysis, graphical presentation and crossing with quantitative variables.

All qualitative analyses (data coding and categorical transformation) were performed using QSR-NVivo, version 10.0, and quantitative/statistical analyses were conducted using ©IBM SPSS (Statistical Package for Social Sciences), version 24.0.

3. Results

First of all, it is important to summarize some key findings on the cycling habits, patterns and crash history found in the study sample. Regarding their trips as cyclists, participants used their bicycles for a mean time of $M = 6.71$ ($SD = 6.34$) hours a week. The average duration of their journeys was $M = 47.5$ ($SD = 42.6$) minutes. Finally, and regardless of the severity, 39.9% of them had suffered at least one traffic crash while cycling during the last 5 years, while 60.1% had not registered any cycling crash.

For what concerns the participants' actual (*real*) reasons for their journeys (most of participants had more than one), it was found that, regarding *utility cycling*: 56.2% (33,9% women and 66.1% men) used the bicycle for regular trips in urban areas; 48.6% (37.9% females and 66.1% males) cycled for very short and concrete trips; finally, only 4.5% (22.9% women and 77.1% men) of participants used bicycling as part of their work activities. As for *non-utilitarian* reasons for cycling, 66.8% of participants (40.2% females and 59.8% males) used the bicycle for recreational or leisure-related purposes, and 37.3% (32% women and 68%) employed the bicycle for performing activities related to fitness or sportive cycling. The extended set of descriptive statistics in this regard is presented in Table 1.

3.1. Hierarchical analyses: reasons for using (or not) the bike as a transport mode

First, and as for the hierarchical analysis on the encouraging reasons for using the bicycle as means of transportation, it was found that the most prevalent motives or reasons (1st) for this election were: physical health and fitness (38%), time saved in comparison to other transport modes (12.1%), and contribution to environmental sustainability (11.2% of participants). As for the second most important reasons (2nd), the most prevalent were: physical health and fitness (27.6%), contribution to the environmental sustainability (17.3%), and economic reasons (14.1% of respondents). Finally, the most prevalent third reasons (3rd) for using the bicycle were: physical health and fitness (20%), economic reasons (16.8%), and contributing to the environmental sustainability (12.8% of study participants). The entire set of percentages for all the reported reasons or motives for cycling can be seen in Table 2.

Regarding the reported discouraging reasons, i.e., for NOT using the bicycle as a transport means, it was found through the hierarchical categorization of responses that the three most prevalent reason (1st) for non-using the bike among participants were: the perceived crash risk (24.4%), the weather factors and conditions (14.1%), the inconvenient long distances to travel and the topography of the road (11.4% of participants). As for the second most important (2nd) reasons, the most prevalent were: the weather factors and conditions (19.3%), the perceived crash risk (15.6%), and the lack of a proper infrastructure for cycling in the participants' areas (13.8% of them). Finally, the most prevalent third reasons (3rd) for not cycling were: the weather factors and conditions (16.6%), long distances to travel and topography (15.6%), and the lack of a proper infrastructure for cycling (11.7% of respondents). The entire set of descriptive statistics is available in Table 3.

3.2. Merged analyses: reasons for using (or not) the bike as a transport means

As a second step, and regardless of their hierarchy, the three reasons provided by respondents were jointly analyzed, through the merging of all answers in two single categories: (1) reasons encouraging the choice of bikes as transport mode, and (2) reasons discouraging their use.

3.3. Overall encouraging reasons

As for the first category, a total of 3079 responses was registered, the most common being "physical health & fitness" (28.6% – 880 responses), followed by "contributing to the environmental sustainability" (13.77% – 424 responses), and,

Table 1
Descriptive statistics on actual cycling reasons among participants of the study.

Actual motives for cycling	Yes		No	
	Frequency	Percent	Frequency	Percent
Regular trip	598	56.2%	466	43.8%
Short trip	517	48.6%	547	51.4%
Recreational	711	66.8%	353	33.2%
Sports - Fitness	397	37.3%	667	62.7%
Work	48	4.5%	1016	95.5%

Table 2
Reasons for choosing the bicycle as a transport mode (hierarchical categorization).

Encouraging Reasons (Hierarchical)	First	Second	Third
Physical health & fitness	38.1%	27.6%	20.0%
Economy	8.9%	14.1%	16.8%
Time saving	12.1%	11.0%	7.3%
Environmental sustainability	11.2%	17.3%	12.8%
Fun & entertainment	4.4%	8.1%	11.1%
Comfort	4.6%	3.7%	5.0%
Avoiding traffic jams	1.1%	2.0%	3.3%
Freedom & independence	4.4%	1.4%	3.1%
Mental health	7.3%	5.5%	7.3%
Fresh air & nature	0.7%	1.1%	1.2%
Avoiding public transport	1.1%	1.6%	1.1%
Efficiency & practicity	4.1%	5.3%	7.4%
Other	2.2%	1.5%	3.5%
Total	100%	100%	100%

Table 3
Reasons for not choosing the bicycle as a transport mode (hierarchical categorization).

Discouraging Reasons (Hierarchical)	First	Second	Third
Thefts/lack of safety	23.7%	13.2%	9.9%
Crash risk	24.4%	15.6%	9.7%
Lack of culture & respect for cyclists	4.1%	7.8%	6.8%
Weather factors	14.1%	19.3%	16.6%
Long distances & topography	11.4%	12.2%	15.6%
Lack of proper infrastructure	9.7%	13.8%	11.7%
Suffered illness	1.8%	3.0%	4.3%
Personal image & sweatness	1.7%	2.8%	4.8%
Low speed	2.1%	2.1%	2.6%
Limited load capacity (people/objects)	1.7%	1.7%	3.9%
Air pollution	1.3%	1.3%	2.0%
Night transport	0.4%	0.9%	1.2%
Malfunctions and need for maintenance	0.1%	1.4%	2.9%
There is no reason	1.9%	1.9%	2.9%
Other	1.8%	3.0%	5.1%
Total	100%	100%	100%

third, those reasons related to the "economics and cost-saving" aspect of cycling (13.25% – 408 responses). The full set of descriptive statistics in this regard is contained in Table 4.

3.4. Overall discouraging reasons

As for the second category, a total of 2722 responses was registered, and the most common were, in decreasing order: perceived crash risk (16.9% – 463 responses), adverse weather conditions (16.64% – 453 responses), and reasons related

Table 4
Reasons encouraging the choice of the bicycle as a transport mode (merged categorization).

Encouraging reason	Frequency	Percentage
Physical health & fitness	881	28.61%
Environmental sustainability	424	13.77%
Economy	408	13.25%
Time saving	312	10.13%
Fun & entertainment	241	7.83%
Mental health	206	6.69%
Efficiency & practicity	172	5.59%
Comfort	137	4.45%
Freedom & independence	90	2.92%
Avoiding traffic jams	66	2.14%
Avoiding public transport	38	1.23%
Fresh air & nature	30	0.97%
Other	74	2.40%
Total	3079	100%

Table 5
Reasons discouraging the choice of the bicycle as a transport mode (merged categorization).

Discouraging reason	Frequency	Percentage
Crash risk	460	16.90%
Weather factors	453	16.64%
Thefts/lack of safety	434	15.94%
Long distances & topography	353	12.97%
Lack of proper infrastructure	318	11.68%
Lack of culture & respect for cyclists	168	6.17%
Suffered illness	80	2.94%
Personal image & sweatness	82	3.01%
Low speed	61	2.24%
Limited load capacity (people/objects)	65	2.39%
Air pollution	42	1.54%
Malfunctions & need for maintenance	38	1.40%
Night transport	22	0.81%
There is no reason	59	2.17%
Other	87	3.20%
Total	2722	100%

to lack of safety and potential thefts (15.94% – 434 responses). The overall percentages and the set of descriptive statistics are contained in Table 5.

3.5. Actual reasons for cycling and suffered traffic crashes

For determining significant statistical trends between the real reasons behind the journeys of participants and the fact of having (or not) suffered at least one cycling crash during the last 5 years, Chi-square independence tests were performed. The results show that in the case of regular trips, short trips, work (utility trips) and sports (non-utility trips), there are significant relationships between the participants' use of the bicycle because of these reasons and the self-reported traffic crashes they suffered when cycling.

In other words, cyclists using the bicycle for regular and short trips were more likely to have suffered traffic crashes, while those using bikes for sports or fitness were less likely to present this self-reported result, as shown in Table 6.

3.6. Main reasons for choosing (or not) cycling, and their relation to traffic crash rates

Finally, and considering the main reasons provided by participants for using or not the bicycle as a transport mode, we performed two descriptive analyses in order to compare self-reported crash rates of cyclists. During the first step, using the reasons supporting cycling, it was found that the higher value of traffic crashes suffered during the previous five years corresponded to those users who considered "freedom & independence" as their main motivation for preferring bikes in their trips (M = 1.0; SD = 1.14), followed by those users reporting "fun & entertainment" (M = 0.93; SD = 1.17), and "breath fresh air & contact with nature" (M = 0.86; SD = 1.21) as their main reasons. The full set of reasons and mean values can be seen in Table 7.

As a second step, the same descriptive analysis was conducted, but considering the main "negative reasons" or reasons that discouraged cycling; it was found that the higher mean value corresponded to users who perceived that there was no

Table 6
Actual reasons for the cycling trips of participants, crossed with the fact of having suffered (or not) a cycling crash in the last 5 years.

Cycling Reasons	Have you suffered a cycling crash (5 years)?	No	Yes	% of Total	Statistic - $X^2_{(1,1064)}$	p-value	Sig.
Regular Trip	No	33.4%	10.4%	43.8%	89.86	0.000	***
	Yes	26.7%	29.5%	56.2%			
Short Trip	No	35.5%	15.9%	51.4%	38.42	0.000	***
	Yes	24.5%	24.1%	48.6%			
Recreational	No	20.2%	13%	33.2%	0.16	0.370	N/S
	Yes	39.8%	27%	66.8%			
Sports - Fitness	No	39.2%	23.5%	62.7%	4.52	0.020	*
	Yes	20.9%	16.4%	37.3%			
Work	No	57.9%	37.6%	95.5%	3.09	0.053	N/S
	Yes	2.2%	2.3%	4.5%			
% of Total (per group)		60.1%	39.9%	100%	– – –		

Notes: ***Sig. at level 0.001; **Sig. at level 0.01; *Sig. at level 0.05; $^{N/S}$Non-significant.

Table 7
Mean number of suffered crashes by main reason encouraging cycling.

Encouraging reason	N	Mean	Std. Deviation	Std. Error	95% CI		Min.	Max.
					Lower	Upper		
Physical health & fitness	394	0.52	0.91	0.05	0.43	0.61	0	5
Economy	92	0.79	1.08	0.11	0.57	1.02	0	5
Time saving	125	0.66	0.93	0.08	0.49	0.82	0	5
Environmental sustainability	116	0.43	0.86	0.08	0.27	0.59	0	5
Fun & entertainment	45	0.93	1.18	0.18	0.58	1.29	0	5
Comfort	48	0.73	1.07	0.15	0.42	1.04	0	4
Avoiding traffic jams	11	0.55	0.82	0.25	−0.01	1.10	0	2
Freedom & independence	45	1.00	1.15	0.17	0.66	1.34	0	5
Mental health	75	0.83	1.17	0.14	0.56	1.10	0	5
Fresh air & nature	7	0.86	1.22	0.46	−0.27	1.98	0	3
Avoiding public transport	11	0.82	0.75	0.23	0.31	1.32	0	2
Efficiency & practicity	42	0.83	1.08	0.17	0.5	1.17	0	5
Other	23	0.61	0.66	0.14	0.32	0.89	0	2
Total	1034	0.64	0.99	0.03	0.58	0.70	0	5

Table 8
Mean number of suffered crashes by main reason for avoiding cycling.

Discouraging reason	N	Mean	Std. Deviation	Std. Error	95% CI		Min.	Max.
					Lower	Upper		
Thefts/lack of safety	230	0.57	0.92	0.06	0.45	0.68	0	5
Crash risk	236	0.61	0.93	0.06	0.50	0.73	0	5
Lack of culture & respect for cyclists	40	0.98	1.12	0.18	0.62	1.33	0	5
Weather factors	137	0.67	1.00	0.09	0.50	0.84	0	5
Long distances & topography	110	0.59	0.77	0.07	0.45	0.74	0	3
Lack of proper infrastructure	94	0.59	0.99	0.10	0.38	0.79	0	5
Suffered illness	17	0.71	1.36	0.33	0.01	1.40	0	5
Personal image & sweatness	16	0.81	1.33	0.33	0.11	1.52	0	4
There is no reason	18	1.44	1.65	0.39	0.62	2.27	0	5
Low speed	20	0.35	1.14	0.25	−0.18	0.88	0	5
Limited load capacity (people/objects)	16	0.69	0.87	0.22	0.22	1.15	0	2
Other	17	0.59	0.87	0.21	0.14	1.04	0	3
Air pollution	13	0.85	0.99	0.27	0.25	1.44	0	3
Night transport	4	0.50	0.58	0.29	−0.42	1.42	0	1
Malfunctions & need for maintenance	8	0.01	0.36	0.17	−0.09	0.12	0	1
Total	976	0.64	0.98	0.03	0.58	0.70	0	5

negative reason influencing the decision of not using the bike as a transport mode ($M = 1.44$; $SD = 1.65$), followed by users perceiving a "lack of culture and respect for cyclists" ($M = 0.98$; $SD = 1.12$), and "air pollution" ($M = 0.85$; $SD = 0.99$). The full set of descriptive statistics on crashes, according to main reasons for avoiding bicycling is available in Table 8.

4. Discussion and conclusion

Based on the responses provided by the 1064 cyclists participating in this research, and bearing in mind the objectives of the study, this paper examined: first, the encouraging and discouraging factors perceived by cyclists which led them to use (or not) this alternative transport mode, and the relationship between the reasons why participants chose to use a bike and the traffic crashes they had suffered during the previous 5 years.

As for the first study's purpose, we found how the most common encouraging reasons for bicycling were principally related to the perception of health benefits, time savings during the journey and environmental contributions. On the other hand, the most common discouraging reasons were related to the perception of traffic crash risks, the interaction with adverse weather conditions and the inconvenience of cycling when traveling long distances and facing difficult topographic conditions. These results reflect both positive and negative factors.

4.1. The encouraging factors

The task of developing more effective cycling policies requires an essential understanding of the key factors which may influence the decision to cycle (Muñoz, Monzon, & López, 2016). In this sense and, keeping in mind the most commonly addressed encouraging factors in sustainable transport policies, the results allow us to affirm that, to a large extent, the participants of our study already considered the bicycle a healthy and sustainable means of transportation. This result is positive

in the light of the need to internalize not only the immediate, but also the mid and long term benefits of choosing alternative transport modes that may strengthen both transport dynamics, i.e., less traffic congestion, air pollution and more numerous cheap alternatives for users in their journeys (DTMR, 2018; Fishman, Schepers & Kamphuis, 2015), and public health, in the form of a mid-term lower prevalence of chronic and preventable diseases, and also a substantial and progressive increase of physical activity within the population (Pucher & Dijkstra, 2003; Woodcock, Tainio, Cheshire, O'Brien, & Goodman, 2014). As for this last element, it is very important to remark that the physical inactivity of the population is thought to generate high economic costs for healthcare systems around the world, being this one of the most important reasons for promoting cycling as a healthy mode of transportation (Hollingworth, Harper, & Hamer, 2015).

4.2. The discouraging factors

In accordance with other empirical studies in this field, factors such as lack of safety, crash risk, weather conditions, long distances & topography were shown to play a relevant role in discouraging the decision of cycling. In this regard, Fernández-Heredia et al. (2014) found that perceived danger, vandalism and orography are significant variables which explain the lack cycling behaviors among users (Goldsmith, 1992; Litman, 2018). Also, Moudon et al. (2005) stated that the most important barriers preventing the promotion of cycling include an insufficient, unfriendly or unsafe infrastructure for the circulation of bicycles, a deficiency of cycling conveniences and unattractive conditions of the ground in circulating zones. On the other hand, recent evidence states that measures on different spheres may enhance the decision of adopting, maintaining and promoting cycling as a transport mode for more and more people, such as: road safety education (Bonham & Johnson, 2018; Johnson, Charlton, Oxley, & Newstead, 2010), the promotion of a broader culture of sustainable and "green" mobility (Jordi-Sánchez, 2018) and the design and implementation of improved and more inclusive infrastructures for cycling (Hull & O'Holleran, 2014), also implying additional efforts directed at the protection of vulnerable road users (such as cyclists) from traffic injuries (Constant & Lagarde, 2010).

4.3. Actual reasons for the journeys and cycling crash rates

As for the second objective of this study, we used both independence tests and graphical tools to assess, respectively, the relationship between perceived and actual (*real*) motives for cycling, and the crashes suffered while cycling during a period of 5 years. It was interesting to find that a more regular use of the bicycle was related to a lower probability of suffering traffic crashes while cycling, in the light of other research experiences highlighting the protective role of safety habits and behaviors, that –similarly to what happens when driving other vehicles- are usually developed through the experience (highly correlated with age) and the adaptation to the cycling task (Poulos et al., 2017; Useche, Alonso, Montoro, & Tomas, 2019; Useche, Montoro, Alonso, & Tortosa, 2018).

In short, we found that the participants who felt more encouraged to cycle for reasons related to sensation seeking, fun and freedom, and who on the other hand felt discouraged by the perceived lack of culture and by air pollution, or who simply did not identify any negative factors related to cycling, were those reporting the higher rates of cycling crashes suffered during the previous 5 years. In this regard, it is interesting to remark the role of the risk perceived by cyclists in traffic crash involvement, bearing in mind that the accumulated evidence supports the fact that users with, among other variables, a lower perception of risks associated with the cycling task, are more likely to suffer cycling crashes and injuries. This makes it important to elaborate training programs based on safe capabilities, attitudes, perceptions and behaviors, as an essential part of road safety education (Frings, Rose, & Ridley, 2012; Twisk, Commandeur, Vlakveld, Shope, & Kok, 2015; Useche et al., 2018).

4.4. Perception, intention and promotion of cycling

But benefits and risks are not uniformly perceived among the entire population. There are certain factors that may explain a major or minor degree of choice and apprehension in practices such as cycling (Heinen & Handy, 2012; Poulos et al., 2015; Useche et al., 2018). In fact, low-cycling countries tend to present the most pronounced gaps and inequities in terms of cycling, often explained in terms of age, gender and reasons related to the journeys (Aldred, Woodcock, & Goodman, 2016). In this sense, the progressive and constant promotion of cycling as a sustainable, efficient and healthy alternative for transportation remains a latent need in some key population groups. For instance, Emond and Handy (2012) found that, in the case of high school students, factors such as parental encouragement, a higher comfort perceived in cycling, and a proper management of the distances traveled (linking them, for instance, to health benefits) may contribute to increase bicycling among young users. Also, and although in the past some programs for increasing bicycling have achieved significant results -between 2% and 3.4%- of cycling journeys (Troelsen, 2005; Wilmink & Hartman, 1987), during the last decades cycling has counted with additional sources of support and promotion, such as the mass-media, the scientific evidence on its benefits for physical and mental health, more iconic actions for involving people in alternative means of transportation, and a growing cycling culture around the world (Caulfield, 2014; Lois et al., 2015).

Another interesting fact that has to be highlighted is the need to improve the efforts aimed at promoting cycling for both women and men, considering the gender disproportionalities still existing in the field (Acheampong, 2016; Heesch, Sahlqvist, & Garrard, 2012). Also, and additionally to the creation of more equity in terms of gender, economics and

demographics, cycling represents an opportunity to integrate healthy practices in the daily life of the community, as long as the risks are managed through safety and infrastructural improvements related to culture (Aldred & Jungnickel, 2014; Lois et al., 2015). There is, in other words, a need to promote *utilitarian cycling*, considering that, normally, recreational or *leisure* cycling takes place with less frequency and length. For this purpose, strategies to build a more user-friendly environment, and to enhance road safety education for all users -not only for cyclists- may support a higher growth of functional and everyday cycling (Bonham & Johnson, 2018; Heesch & Sahlqvist, 2013).

5. Limitations of the study and further research

Although our sample size was considerably large, and participants were from different countries (factor that allowed us to study the reasons for cycling from a wider perspective), some specific issues of this research should be listed as potential sources of bias. First of all, the study is based on a self-report data collection method, which remains vulnerable to common method biases that may affect the reliability of the reported results, especially considering that our questionnaire asked for information that - although the survey was anonymous- may feel uncomfortable or compromising for participants, such as in the case of their specific transport habits and crashes suffered (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Rosenman, Tennekoon, & Hill, 2011). As an example, other empirical experiences have stated that in this type of studies participants might provide the information they believe their counterpart wants to receive or might try to give a "right" answer (Heinen & Handy, 2012). Secondly, we should highlight that one of the most important strengths of this study was the involvement of participants from several countries; however, this may also represent a weakness, if we consider that different cycling-related legislations, infrastructural developments and bike-culture-related issues among countries may affect the perception of cyclists depending on their region, preventing us from being able to make further generalizations of the trends we found. And thirdly, our sampling technique may explain the over-representation of subjects belonging to higher educational levels. Then, there is a question that remains unanswered: "What about other groups of urban cyclists, such as commuters and workers (e.g. bike messengers), whose rapid growth has also had an impact on transportation dynamics?", stated with the aim of encouraging further studies to explore these relevant segments of urban cycling.

Finally, for what concerns further research in this field, we would like to propose two main suggestions: first, it might be very useful for analytic purposes to consider in-depth questions about specific crash-related factors, such the severity of the crash; and secondly, to analyze, together with the study of factors affecting the intention of cycling and the severity of crashes, the users' perception of cycling-infrastructure development, as well as the social discussion related to this topic and the inclusiveness of cycling in the participants' regions of provenance, considering that all of these are very important factors which could explain future differential trends and patterns in the growth of cycling.

6. Authors' contributions

SA Useche: Study Design, Data Collection and Analysis, Manuscript Writing.
L Montoro: Literature Research and Review, Manuscript Writing.
J Sanmartin: Literature Review, Manuscript Editing.
F Alonso: Study Design, Content Planning.

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Conflicts of interest

The authors declare no competing interests.

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