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Artículo

RESUMEN

Aunque muchas metrópolis latinoamericanas disponen de trenes de cercanías, se ha prestado poca atención a su integración con modos no motorizados. En consecuencia, se está perdiendo la oportunidad de ampliar la cobertura del tren en el último kilómetro/milla del viaje. Considerando que existen pocas investigaciones sobre la integración tren-bicicleta en América Latina, el objetivo de este estudio es identificar, clasificar y definir los factores que inciden en la integración bicicleta-tren regional en ciudades periféricas vinculadas a regiones metropolitanas. A tal fin, a través del análisis del estado del arte, se construye una clasificación de seis factores, 17 componentes y 100 variables. Las variables son analizadas con base en su relevancia y su efecto en la promoción de la integración tren-bicicleta. Se observa que el factor seguridad es trasversal al resto de los factores y la infraestructura puede ser considerada como el más relevante al ofrecer condiciones adecuadas para el ciclismo.

Palabras clave: Integración modal; tren-bicicleta; intermodalidad; América Latina.

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Integración Bicicleta-Tren de cercanías: ¿Qué consideran los usuarios en los viajes pendulares?

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ABSTRACT

Bike and train intermodality: ¿What are users considering when commuting?

Latin America has made important investments in the construction of commuter trains. However, not enough attention has been paid to their integration with non-motorized transport modes. The consequences are clear: the opportunity to increase train stations' coverage with last mile trips is lost. Taking into account the lack of research on this topic, especially in Latin America, this study's objective is to identify, classify and define the factors that influence modal choice when using bike and train intermodality. Through a bibliographic review and analysis, especially of Latin American studies, a classification of six factors, 17 components and more than 100 variables is obtained. The most important variables are analyzed by its importance and how it affects the intermodality, by either encouraging or discouraging it. Some factors included are safety and infrastructure. The latter could be considered the most important, because it allows the incorporation of adequate conditions for cycling.

Key words: transit-bicycle integration, intermodality, Latin America

Introduction

Nowadays, cities around the world are prioritizing the implementation of public transport policies that are attached to a certain type of sustainable mobility strategy (Banco Mundial, 2002; Miralles-Guasch & Cebollada, 2003; PROBICI, 2010). One of the most successful approaches has been the construction of cyclist infrastructure to promote bicycles as a mode of transport for last mile trips (ITDP, 2013; ITDP, 2013a; Martens, 2004). This infrastructure allows bicycles to easily integrate with traditional public transport systems, especially with commuter trains that connect the core of cities with their suburban areas (Adjei, 2010; Pucher & Buehler, 2009; Rietveld, 2000; TCRP, 2005).

The construction of commuter trains in metropolitan areas is oriented to solve congestion problems due to high automobile dependency (Lizárraga, 2006; Lupano & Sánchez, 2009). The role of bicycles as a feeding mode has a great impact on mobility increasing train station's coverage area with last mile trips (Martens, 2004; Rivasplata, 2013). Bike and train intermodality, from now on BTI, drastically decreases travel time and offers multiple benefits for users living in suburban areas and commuting every day to the core city (Martens, 2004). When more and more people in peripheral cities rethink their travel patterns and start using BTI, mobility problems start to revert.

Nevertheless in Caracas Metropolitan Region (CMR), no commuter train in construction or constructed has incorporated cyclist infrastructure to allow BTI. When reviewing bibliographic material, there are no studies related to BTI in Venezuela. Even in Latin America, the subject is barely addressed. The consequences are clear: we are losing the opportunity to increase train stations' coverage with last mile trips, promoting a more sustainable mobility. Consequently, by studying this subject we are also filling the gap hole on academic literature related to BTI, especially in Latin American cities, being this study a reference for planners to have an integral point of view, with criterion and a complete range of considerations to work with BTI. Because in Latin American, and specially Venezuela, what usually happens is that authorities, planners and policy makers tend to simplify the addressing of BTI to the mere construction of bikeways, leaving out of consideration multiple variables related to infrastructure and other factors that also are part of what users consider when commuting with BTI. Therefore, this study's objective is to identify, classify and define the factors that influence modal choice when using BTI.

This article covers only the first part of a research carried out at Simon Bolivar University. The document not only classifies the factors, but also performs an exploratory study on CMR users' preferences for the factors related to BTI. This paper's scope is not showing the results of this exploratory study but the classification's construction process based on the bibliographic review and how each factor affects BTI. However, some of the survey results will be referenced when describing the most relevant variables classified (Arias, 2017).

The first part of this document addresses previous studies related to BTI. The second part refers to the process of construction of the classification obtained, identifying and classifying the factors that influence BTI. The third part defines the factors, components and the most important variables of the classification, describing their importance for BTI and how it affects it (by encouraging or discouraging it). Many of the aspects analyzed in this article, encourage or discourage the use of bicycles in general, not exclusively BTI. Nevertheless, by encouraging the use of bicycle, it automatically favors the use of BTI. At the end the most important findings related to BTI factors are discussed for further policy making.

2.Previous studies related to bike and train intermodality

Bike and train intermodality (BTI) has been scarcely addressed in Venezuela. We only found studies related to the integration of bikes with bus services, but no study was found related specifically to bike and commuter train integration. In the case of Latin America, some studies show an effort to identify and classify factors that are related to BTI. Gouvea and Paiva (2008) found two main elements and more than 10 relevant variables to consider when analyzing modal integration between bikes and public transport systems in Rio de Janeiro, Brazil. She found safety and transport cost were the two most important variables.

Da Silva (2005) analyzed the integration of bicycles with suburban buses and commuter trains, identifying two main topics, three components and 19 specific variables related to this type of integration in El Salvador, another Brazilian city. The author found 57% of non-regular cyclists reported road safety as their main barrier for not using the intermodality, 20% claimed inadequate road pavement conditions and 12% poor signage. As motivators, users reported health conditions (33%), transport cost (23%) and travel time (18%). Transport cost was a relevant variable, especially for those who live in suburban areas showing in fact, that some regular cyclists tend to travel up to 10 km to access train stations in order to save the last mile cost of transportation (bus service or cab).

Silva, Pinto, Ribeiro and Delgado (2014) also studied the Brazilian city El Salvador classifying five main elements and 21 variables, and founding that public safety was the most important one. Respondents claimed they were scare of using bikes at night and some of them reported freight transport's high speed as a barrier due to generated noise and strong breeze that usually cause accidents. Finally, De Paiva (2013) is perhaps whom made the most extensive factors classification. She obtained a classification of nine main areas and more than 40 elements influencing the use of bike and metro (subway) integration in Distrito Federal of Brazil. Transport cost, environmental benefits and flexibility were identified as the most important motives for the use of the intermodality. In contrast, bicycle thefts in parking lots and road safety are the main elements that discourage it.

Based on these previous studies reviewed and other bibliographic material, a classification of six factors, 17 components and 118 variables related to BTI was obtained (see Table 1).

3. Methodology: classification's construction process

Firstly we made an extensive bibliographic review, including previous studies related to modal integration between bicycles and public transport systems and also international experiences about modal integration in general. These documents were filtered from 2000 forward because in previous years, studies were very often related to road safety whereas in more recent years, modal integration have been the most relevant topic (Silveria & Maia, 2012). Our bibliographic review was oriented primarily to Latin American studies, articles and theses. We found 39 studies related to modal integration between bicycles and public transport systems in general (15 of them were from Latin American cities), creating a bibliographic support for the classification.

A total of ten studies (out of the 39) had some type of classification of elements as seen in Table 1. We observed that they usually use two levels of classification, but some of them use three levels: one on the top for general topics, an intermediate level that connects the general areas with specific ones and the last one for variables. This was the type of classification we chose: factors, components and variables. The factors make up the general thematic areas that cover a central aspect; components are sub-thematic areas related to a general topic and then at the specific level (micro-level) are variables.

#	YEAR AUTHO R (S)	OBJECTIVE STUDY CASE	AREA OF INTEREST	TYPE OF CLASSIFICATION
1	2002 Pezzuto, C. & Da Penha, S.	This article reviews several programs and policies that promote the use of bicycles as a mode of transport. Through a survey it verifies the perception of Brazilian users and which factors encourage or discourage the use of bikes. Based on the results, some policies are highlighted to implement in Brazilian medium size cities. *Case of study: Araçatuba, Brazil.*	CYCLIST INFRASTR UCTURE	Level 1 general: 1 criterion. Level 2 intermediate: 3 sub-criteria. Level 3 specific: 15 variables. Results: exploratory study where results are expressed in descriptive and frequency analysis.
2	2005 Da Silva, D.	Evaluate the main factors that influence the individual's decision to use bicycles for their daily trips. *Case of study: El Salvador, Brazil.*	BICYCLE-MASIVE TRANSIT SYSTEM	Level 1 general: 2 thematic areas. Level 2 intermediate: 3 criteria. Level 3 specific: 19 variables. Results: exploratory study where results are expressed in descriptive and frequency analysis.
3	2008 Gouvea, V. & Paiva, M.	This study classifies two criteria and 11 sub-criteria that are relevant for bicycle users when using modal integration to help planners decide where to implement bike parking integrated to public transport systems. An analysis and procedure is presented to obtain an index that prioritizes location options from a user-oriented point of view. *Case of study: Rio de Janeiro, Brazil.*	BICYCLE-PUBLIC TRANSPOR T SYSTEM	Level 1 general: 2 criteria. Level 3 specific: 11 sub-criteria. Results: expressed in the relative weight of the variable to impact modal integration.
4	2010 PROBICI	Guideline for the efficient implementation of bicycles as modes of transport in cities, providing global criteria and presenting good practices around the world. *Case of study: not applicable.*	BICYCLE-PUBLIC TRANSPOR T SYSTEM	Level 1 general: 2 criteria. Level 2 intermediate: 8 sub-criteria. Level 3 specific: 27 factors. Results: exploratory study where results are expressed in descriptive and frequency analysis.

Table 1 Studies that classify variables related to modal integration of bicycles and public transport systems. Source: prepared by authors on the basis of bibliographic support.

5	2011 Heinen, E., Maat, K. & Wee, B.	This paper analyses the influence of commuters' attitudes toward the benefits of travel by bicycle (e.g. convenience, low cost, health benefits) on the mode choice decision for commutes to work. *Case of Study: Deft, Zwolle, Midden–Delfland and Pijnacker–Nootdorp, The Netherlands.*	CYCLIST INFRASTRUCTURE	Level 1 general: 3 factors. Level 3 specific: 14 variables. Results: probabilities of variables impacting modal choice when commuting in bicycles for different distances.
6	2011 Kirner, J. & Da Penha, S.	The paper describes research developed to define which roadway and traffic characteristics are prioritized by users and potential users in the evaluation of quality of roads for bicycling in urban areas of Brazilian medium-sized cities. *Case of study: Sao Carlos and Rio Claro, Brazil.*	CYCLIST INFRASTRUCTURE	Level 1 general: 4 criteria. Level 3 specific: 14 variables. Results: expressed in the relative weight of the variable to impact user's preference for specific cyclist infrastructure.
7	2012 Buehler, R.	This article evaluates the impact of some end-of-trip facilities in workplaces to increase commuting in bicycles. The facilities evaluated are: bike parking, showers and free parking for employees. *Case of Study: Washington DC, United States.*	CYCLIST INFRASTRUCTURE	Level 1 general: 6 determinants. Level 3 specific: 16 variables. Results: expressed in the probability of the variable for commuting in bicycle.
8	2013 De Paiva, M.	Identify the factors that impact on bike-subway modal integration. *Case of study: Distrito Federal, Brazil.*	BICYCLE-MASIVE TRANSIT SYSTEM	Level 1 general: 9 thematic areas. Level 3 specific: 44 criteria. Results: expressed in the relative weight of the variable to impact modal integration of bikes and subway system.
9	2014 Silva, A., Pinto, I., Ribeiro, D. & Delgado, J.	The development of a method to assist in evaluating the "best" cycling route integrated to public transportation and to consider among other criteria, the factors of individual choice of cyclists. *Case of study: El Salvador, Brazil*.	BICYCLE-PUBLIC TRANSPORT SYSTEM	Level 1 general: 5 thematic areas. Level 3 specific: 21 factors. Results: exploratory study where results are expressed in descriptive and frequency analysis.
10	2014 Caulfield, B., Brick, E. & McCarthy, O.	This paper examines infrastructure preferences for cyclists and determines the factors that have the greatest influence on the correlation between the level of cycling confidence and preferred types of infrastructure and route characteristics. *Case of study: Dublin, Ireland.*	CYCLIST INFRASTRUCTURE	Level 1 general: 5 factors. Level 3 specific: 16 variables. Results: expressed in probabilities of users preferring a specific cyclist infrastructure.

Table 1. (Cont.) Studies that classify variables related to modal integration of bicycles and public transport systems. Source: prepared by authors on the basis of bibliographic support.

For each of the 39 documents reviewed we did a summary containing the main objectives, results and key words or variables that were found to be relevant in the specific intermodality analyzed. We grouped the variables into components with similar thematic areas and all components where associated with a general topic or factor. The classification of six factors, 17 components and 118 variables was obtained as seen in Table 2. The two components of the classification that grouped more variables were "bikeway infrastructure and transit conditions" in addition to "intermodal stations facilities" with 20 variables each one. When analyzing factors, the "cyclist infrastructure and facilities" factor concentrated 48.31% of the variables, being followed by "personal characteristics" with 16.95% and "travel characteristics" with 16.10%.

FACTOR	COMPONENT	VARIABLES ABS.	VARIABLES %
SAFETY	PUBLIC SAFETY	3	2,54
	ROAD SAFETY	1	0,85
	SUBTOTAL	4	3,39
CYCLIST INFRASTRUCTURE AND FACILITIES	BIKEWAY AND TRANSIT CONDITIONS	20	16,95
	INTERMODAL STATION FACILITIES	20	16,95
	BIKE PARKING	11	9,32
	BIKE RACKS ON TRAIN AND END-OF-TRIP FACILITIES	6	5,08
	SUBTOTAL	57	48,31
URBAN PHYSICAL-ENVIRONMENTAL CONDITIONS	ENRIVOMENT CONDITIONS	7	5,93
	PHYSICAL CONDITIONS	4	3,39
	SUBTOTAL	11	9,32
TRAVEL CHARACTERISTICS	TIME	6	5,08
	DISTANCE	5	4,24
	COST	5	4,24
	TRIP PURPOSE	3	2,54
	SUBTOTAL	19	16,10
PERSONAL CHARACTERISTICS	SOCIO-DEMOGRAPHIC CONDITIONS	16	13,56
	PSYCHOLOGICAL CHARACTERISTICS	4	3,39
	SUBTOTAL	20	16,95
POLITICAL-LEGAL	POLITIC WILLINGNESS	2	1,69
	LEGISLATION	2	1,69

Table 2 Classification of six factors, 17 components and 118 variables related to bike and train intermodality. Source: prepared by authors on the basis of bibliographic support.

All variables identified in the 39 summaries were then sort out in an Excel database. A frequency analysis was carried out to count how many studies mentioned any of these variables as relevant for the intermodality. Our hypothesis was that if a variable is more frequently mentioned, then its relevance is higher. We established three frequency ranges: low frequency for those variables mentioned in up to eight studies, intermediate frequency for those mentioned from nine to 17 studies and high frequency for those mentioned in more than 18 studies.

The results of the frequency analysis showed that 17.80% of all variables were in the high frequency range, 46.61% in the intermediate level and 35.59% in the low range (see Table 3). "Safety" factor concentrates two out of four variables in the high frequency range. In the case of "cyclist infrastructure and facilities" and "urban-physical environmental conditions" factors the majority of variables are in the intermediate frequency range. "Travel characteristics", "personal characteristics" and "political-legal" factors concentrate the majority of their variables in the low frequency range. Moreover, the political legal factor has no variable in the high frequency level.

Factor	Frequency analysis: Low (0-8 studies)	Frequency analysis: Intermediate (9-17 studies)	Frequency analysis: High (18-39 studies)	Total of variables per Factor
Safety	1	1	2	4
Cyclist infrastructure and facilities	18	34	5	57
Urban physical-environmental conditions	1	7	3	11
Travel characteristics	7	6	6	19
Personal characteristics	10	5	5	20
Political-legal	5	2	0	7
Total of variables per freq. range (abs. and %)	42	55	21	**118**
	35,59%	46,61%	17,80%	**100,00%**

Table 3 Frequency analysis results per factor. Source: prepared by authors on the basis of bibliographic support.

When we deep into the high frequency range variables, we observe "theft" was the most relevant of all, being mentioned in 30 of 39 studies reviewed as seen in Figure 1. Accidents and cost of transport were also relevant being mentioned in 28 of 39 studies.

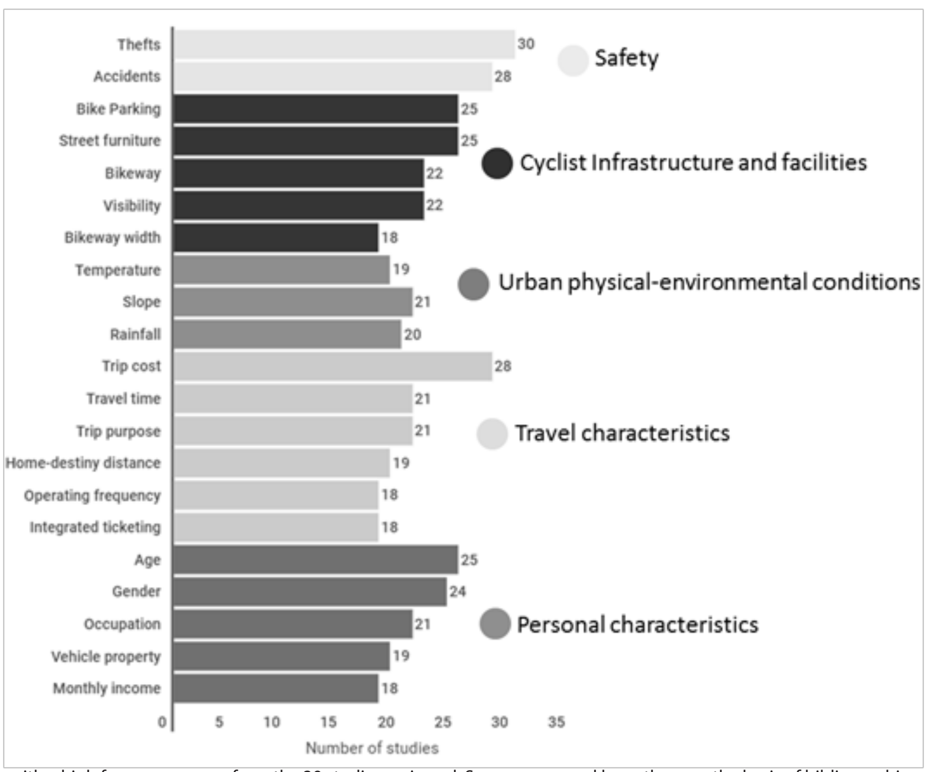

Figure 1 Variables with a high frequency range from the 39 studies reviewed. Source: prepared by authors on the basis of bibliographic support.

A discussion of the total 118 variables classified will take more pages than what's expected, so a selection of the most relevant ones is made based on what was found to be more important for users when considering commuting with BTI. This analysis from a user-oriented prospective will bring a general sense of what they expect when using BTI so that planners can consider these aspects when constructing commuter trains, especially in suburban areas.

4. What are users' considering when using bike and train intermodality?

4.1.1. In relation to safety factor

Defined as the number of accidents and criminal acts registered in the station's surroundings (Gouvea & Paiva, 2008), safety is the most important factor classified. All the other factors are transversally related to this first one, because risk perception is the most important barrier for the use of bicycles as a mode of transport (Heinen, Maat & Van Wee, 2011). Safety though, has two approaches: public and road safety. The first one considers all urban space attributes that guarantee a secure environment for cyclists reducing the occurrence of thefts (PROBICI, 2010). The second one refers to infrastructure conditions and speed limit regulations that reduce the occurrence of accidents (Barrera & Knoblauch, 2004; Flórez & Patiño, 2014; Kirner & Da Penha, 2011).

Bicycle theft is the most important variable and it discourages BTI because users perceive a greater risk and get scared of cycling when they are robbed or they hear cases of bicycle robbery. Bike thefts mostly occur in public spaces, often due to an inadequate location and poor lighting and shelter conditions (IDAE, 2009). Cycling at night is also one of the main barriers because lonelier and darker streets increase danger perception in users, especially women (Silva et al, 2014; Heinen et al, 2011). In contrast, the presence of police officers or security personal encourages BTI, bringing a general sense of a safe environment (PROBICI, 2010). For the study case of CMR users, this factor becomes vital to promote the use of bicycles because insecurity levels and accidents in Caracas are higher than other Latin American cities so users feel more insecure (IMUTC, 2012). Arias (2017) found that 54.23% of CMR users perceive cycling at night as a restriction. When analyzing results by gender, the barrier gets a bigger proportion for women: 66.66% of them wouldn't cycle at night compared to the 43.51% of men that perceive this as a barrier (Arias, 2017). Da Silva (2005) found that in the suburban train station called Acaré near Sao Paulo some BTI users even pay a cheap fare for "bicycles keepers" to guard their bike while parked during the work day.

Accidents are another important variable of this factor, discouraging BTI because it increases user's risk perception especially at intersections, streets with bends and a great slope (Flórez & Patiño, 2009). They occur in most cases due to vehicle speed and volume. High speed tends to be a discouraging variable for BTI because users feel insecure and vulnerable. In contrast, when vehicle speed is under 30 km/hr or slower, it positively influences BTI because cycling becomes faster than driving a car (kirner & Da Penha, 2011). Another issue related to road safety is vehicle volume. Some users prefer to ride bicycles in streets with low vehicle volume because they feel safer riding alone with no cars. But other users prefer to ride in streets with high vehicle volume (with speed limits under 30 km/hr), because they feel safer when more people are around (Da Silva, 2005, Barrera & Knoblauch, 2004; Kirner & Da Penha, 2011).

4.1.2. In relation to cyclist infrastructure factor

Cyclist infrastructure is perhaps one of the most important factors because it allows planners and policy makers to offer better safety conditions and reduce user's danger perception when considering commuting in bicycles. Cyclist infrastructure concentrates all physical implementations or treatments to promote the exclusive or shared circulation of bicycles in streets (PROBICI, 2010; NACTO, 2011). This factor has four components: 1) bikeways and transit conditions, 2) intermodal station facilities, 3) bike parking and 4) bike racks on train and end-of-trip facilities. The first component refers to all street implementations and conditions to allow cyclist's access to train stations (ITDP, 2011). Intermodal station's facilities are all attributes, services and facilities allowing cyclist to make faster, easier and more efficient transferences (TCRP, 2005; Rietveld, 2000). And the last two components refer to the facilities installed in the train station (in the case of bike parking) and into the train wagons and destination buildings (in the case of bike racks and trip-end facilities), to allow the two main options of modal chains involving BTI to be carried out (IDAE, 2009; TCRP, 2005) (see Figure 2).

The first modal chain involves those users that access modal stations in bicycles, leave them parked and continue their trip in commuter trains and use an egress mode to arrive to destiny. The second modal chain involves the same access mode but instead of leaving their bike parked at train stations, users carry them into the commuter train and once they arrive, continue their trip cycling until final destiny.

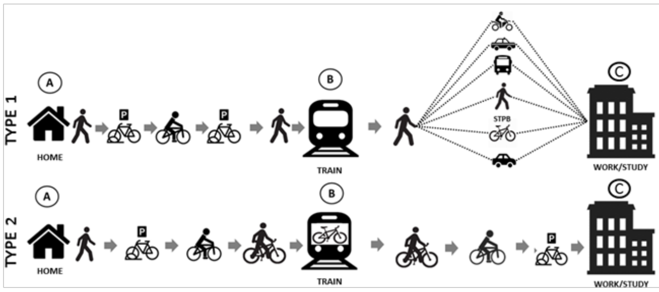

Figure 2 Modal chains involving BTI. Source: elaborated by authors.

When users consider cyclist infrastructure, the availability and type of bikeway are one of the most relevant variables associated with this factor. NACTO (2011) defines two main types of bikeway: cycle lanes for shared circulation of bicycles and other modalities and cycle tracks for exclusive circulation of cyclists. Usually users prefer cycle tracks because they are separated from vehicle transit, making them feel safer (Buehler, 2012; Plaut, 2005). However, some studies (Pucher, Dill & Handy, 2010) show men often prefer cycle lanes more than women, because they feel like they lose time while trying to access or egress from cycle tracks, instead of sharing circulation with vehicles and being able to go faster. In the case of CMR users, they preferred cycle tracks and it is also important to highlight that 62.19% of them wouldn't cycle to train stations if there wasn't a bikeway available to cover last mile trips (Arias, 2017). Whichever bikeway type, all studies show that the construction of bikeways has a positive influence on BTI (PROBICI, 2010, TCRP, 2005). An example of how attractive cycling becomes when having an adequate bikeway network is seen in Bogotá, Colombia. Compared to other cities in Latin America, Bogotá has a high modal share of cycling trips (3.3%) because it has the most large bikeway network in the whole region with 392 km of bikeways (Massink et al, 2011).

Urban obstacles are another variable related to transit conditions that influences negatively on BTI, because cyclists need to maneuver and skip them increasing the risk of accidents. Street furniture must then be adequately located through good street design. Bikeways should also be effectively marked, lighted and signalized. These variables are key elements for users to know where to go and how to ride, avoiding accidents, and influencing positively on BTI (Barrera & Knoblauch, 2004).

One of the most important pavement markings are: predictable bicycle crossings and bike boxes located at intersections. The first one allows cyclists to be more visible and predictable by following an anticipated path when crossing intersections so that all drivers are more aware of them. Bike boxes on the other hand, offer an advance stop for cyclists to wait for traffic lights to change, being more visible for automobiles and having a lead window when moving forward (NACTO, 2011).

Bike parking is also an important variable of this factor. Parking capacity influences positively in BTI because users feel secure to leave their bikes near the station's entrance or in their destiny (IDAE, 2009). To be attractive for users, bike parking must be visible, well lighted, secure and sheltered (IDAE, 2009; TCRP, 2005). When commuting in bicycles users value a lot their travel time, so integrated-ticketing influences positively on BTI, because users can pay for the two services at once in a fast way.

Related to intermodal stations facilities, Rietveld (2000) studied access trips in suburban train stations from the Netherlands and found 35% were made in bicycles. Martens (2004) studied the same subject in the Netherlands, United Kingdom and Germany and reported 22% of access trips were made in bicycles at urban metro stations, whereas this percentage increased to 43% in suburban commuter train stations. These two studies arrived at the same conclusion: as the distance between the user's home and work/study place increases, modal integration becomes more attractive. When intermodal stations have facilities to easily access train stations and make safe transferences, BTI becomes even more attractive. Wheeling ramps, sidewalk ramps, cyclist turnstiles and other facilities increase accessibility and shorten travel time for cyclists. Wheeling ramps were found a relevant access facility because in most cases, mechanical stairs are restricted for the use of cyclists in peak hours (Rietveld 2000; TCRP, 2005).

When users use modal integration type 2, bike racks in wagon become an important variable because it guarantees a comfortable commute trip, where the user can sit and leave his/her bike safe. In the case of CMR users, they will prefer to carry their bikes inside wagons, instead of parking them when commuting (Arias, 2017). This may have to do with the fact that bicycle thefts in Caracas are a real threat making user's risk perception higher when considering leaving their bikes parked so far away during more than couple hours. In most countries though, there are period restrictions to carry bikes in the train because they take out space in peak hours, discouraging BTI; this usually generates discomfort annoyance in BTI users because they need to travel in peak hours for commuting.

When using the second type of modal integration, especial facilities at work may encourage BTI. End-of-trip facilities like bathrooms with showers, dressing rooms, lockers, free bike parking and other facilities function as motivators for users to commute in bicycles (Buehler, 2012; Plaut, 2005; Pucher et al., 2010). In contrast, having free car parking at work may reduce in 70% the possibilities of using bikes for commuting (Buehler, 2012).

4.1.3. In relation to urban physical-environmental conditions factor

Urban physical and environmental conditions refer to natural and physical attributes that characterizes an urban area (De Paiva, 2013; PROBICI, 2010). Regarding natural conditions, slopes are one of the most important variables and it negatively influences BTI because users need to do more effort and cycling becomes a fatiguing task (Vandenbulcke, et al 2011). Other variables that influence in a negative way BTI are extreme temperatures and precipitation levels, because users feel uncomfortable (sweating or freezing) and wet/snowed pavement becomes dangerous (Adjei, 2010; Da Silva, 2005; De Paiva, 2013). An environmental variable that influences positively on BTI is vegetation because trees bring shadow when there are hot temperatures and also they enhance streets (De Paiva, 2013). In the case of CMR users, slopes represent a barrier for the use of bicycles to 48.26% of respondents (Arias, 2017). Extreme temperatures and weather conditions were found relevant in the bibliographic review (Adjei, 2010; Martens, 2004; Vandenbulcke, et al 2011).

On the other hand, land use, town size and the number of intersections that bikeways have are some of the most important variables about physical conditions. Developing compact cities with high density activities and diverse land uses will reduce automobile's dependency encouraging BTI (Asadi-Shekari, Moeinaddini, Sultan, Zaly, & Hamzah, 2015). In relation to bikeways intersections produced by urban design (street network design) (Rodrigues et al, 2014) they influence negatively on BTI because is where most accidents occur (Asadi-Shekari et al., 2015), so if the bikeway has less intersections, it will be more attractive for BTI.

4.1.4. In relation to travel characteristics factor

Travel characteristics group elements related to trip considering distances, time, purpose and cost (PROBICI, 2010). Related to distances, as we said before, BTI is more attractive for users living in suburban areas (Martens, 2004; Rietveld, 2000). Access distances may go from 1.8 km to 7.5 km (Da Silva, 2005; IDTP, 2011, Martens 2004; PROBICI, 2010; Rivasplata, 2013), those distances greater than 10 km influence negatively in BTI because users need to do more effort and other motorized modalities may be seen more convenient.

When considering travel time, one of the variables that influences positively on BTI is the congestion level of the city because users see bicycles as a mode of transport to save travel time (ITDP, 2013). In relation to travel purpose, mandatory dressing codes and the need to carry heavy belongings influence negatively on BTI, especially in women (Plaut, 2015). In addition, travel cost may influence positively on BTI when bike parking at destiny is free and car parking is very expensive (Plaut, 2015). Usually using BTI is cheaper than using other modalities, so this often is a motivator to change travel patterns. In Brazil, Da Silva (2005) found most users in suburban areas cycle up to 15 km to access train stations just to avoid paying the bus service's fare which is very expensive. Another variable that encourages BTI is to offer workers an extra income for commuting in bicycles (Buehler, 2012; Plaut, 2015; Pucher et al., 2010). Studies show this is one of the most effective public policies to invite users to start cycling, because most of them are usually trying to expend less on transport costs.

4.1.5. In relation to personal characteristics factor

Personal characteristics refer to all attributes of cyclists involving socio-demographic and psychological conditions (PROBICI, 2010). Age, gender, monthly income, vehicle property and having children are all important variables of this factor. Age can influence positively on BTI when cyclists are young because usually they don't have a license, they can't afford an automobile and they have better physical conditions (Vandenbulcke et al., 2011). When analyzing gender-gaps, we find in the bibliographic review that women ride less than men, because they have a greater risk perception, they have more restricted dressing codes, when they have children they usually use automobiles, they carry more belongings and they often are more aware of their personal appearance (Buehler, 2012; Da Silva, 2005; de la Paz Díaz, 2017; De Paiva, 2013; Lemos et al, 2017; ITDP, 2011; Plaut, 2015). Vehicle property influences negatively on BTI, reducing up to 77% the probabilities of commuting in bicycle (Buehler, 2012); meanwhile having a bicycle at home encourages BTI (De Paiva, 2013).

Regarding psychological conditions, the bibliographic review shows that Latin American countries have a cultural association of bicycles with poverty (Paiva, 2013). This has to be overcome with campaigns oriented to emphasize that using bikes creates a sustainable lifestyle showing its benefits in terms of health conditions, travel time and cost savings (PROBICI, 2010). And most important, this component groups all elements related to user's risk perception which is very subjective based on the user experience. If a user doesn't know how to ride a bike or has had bad experiences with accidents or a bike robbery, then probably his/her risk perception will be higher having more restrictions.

4.1.6. In relation to political-legal factor

Political-legal variables were the least relevant found in the frequency analysis; in fact none of its variables were in the high frequency range. This factor refers to all public policy oriented to promote the use of bicycles as a mode of transport (Lupano & Sánchez, 2009; PROBICI, 2010; Pucher et al., 2010). One of the most important variables is public events promoting cycling, as the "bike to work day". In Seattle (USA), the number of cyclists commuting on a bicycle for the first time went from 845 in 2004 to 2.500 in 2008 after a series of public events of this type. In San Francisco (USA) bicycle counts were 100% higher in a "bike to work" day in 2008, and 25% higher a few weeks later of the event (Pucher, Dill, & Handy, 2010). Making it possible with safe conditions, for new users to try to commute in bicycle will positively influence BTI because they will gain experience and their perception of danger could be reduce when observing the benefits of cycling. Teaching people how to ride bicycles, especially in younger generations will also encourage BTI and also legislation must respond to a change of paradigms on urban mobility (De Paiva, 2013; TCRP, 2005). Restrictions for automobiles as free-car zones, traffic calming actions, restrictive car parking at the center city are all motivators for BTI, making bicycles a convenient transport alternative (Pucher et al, 2010). In Venezuela, and in most Latin American countries, cities are planned for automobile's dependency so this constitutes one of the top challenges that authorities need to address (Portugal et al. 2010; Rodrigues et al, 2014).

5.Conclusions oriented to policy makers

The objective of this article was achieved by completing a classification of factors, components and variables related to BTI. This classification increases existing information related to this topic for Latin American countries, and especially Venezuela, where no other similar study was found. Studying each of the variables classified related to BTI and making an emphasis on a Latin American socio-cultural context is taking a step forward for more sustainable cities, because analysis are done considering contextual particularities, being more adequate to user's preferences. In other words, socio-economic issues, as well as accessibility conditions or the scarce and poorly maintained infrastructure are all examples of aspects that have to be addressed differently in Latin America than European or North American cities, because we clearly have different conditions, so planners need to have a different approach. This article not only identifies the factors, components and variables related to BTI, but also describes the impact of each of these variables by either encouraging or discouraging cycling in general or using bike and train intermodality.

The bibliographic review and its analysis allowed the understanding of the fact that BTI is not just about constructing bikeways with no adequate conditions and expect users to start cycling. BTI covers multiple factors and users are considering a wide range of variables when deciding to commute with BTI. Therefore planners have to consider them and propose strategies in each of these factors classified to really create adequate cyclist infrastructure conditions that will reduce risk and its perception.

We have found that most users won't cycle if there aren't bikeways available; also there is a general preference for cycle tracks instead of cycle lanes, especially by women. Planners must dedicate as much effort and time to street design and bikeway design in particular, as they do to building or highways design considering all aspects like markings, lighting, signage, pavement conditions, flow-direction, adjacent vehicle speed and volume, and other multiple variables to create safe and comfortable conditions to ride. Urban and transport planners need to establish efficient cycling networks that will allow residential areas in suburban cities to be served with bikeways that access train stations.

When arriving at the commuter train station, bike parking must be available, near the entrance and sheltered, lighted and in well guarding conditions. If a user wish to travel in the train with his/her bike, then there must be sidewalk ramps, wheeling ramps in all stairs, turnstiles for cyclist access, integrated ticketing and bike racks or special wagons destined to host BTI users.

Public policy must be oriented to restrict automobile's use and in also offer adequate infrastructure conditions for the use of public transport systems and non-motorized transport modes. Authorities need to establish cooperation with public and private employment sector to address conditions for BTI users at work like the installation of free bike parking, bathrooms, showers, lockers and extra income bonus for employees that commute in bicycles. Automobile restrictions such as car-free zones, traffic calming interventions, speed limit regulation, expensive parking and fuel costs, and other strategies will be all promoting the use of bicycles, and so it will favor BTI. The literature review also showed that as distances between home and destination get longer, the more attractive BTI becomes. This could serve as a guideline for planners to prioritize efforts of promoting BTI for users living in suburban cities that will cycle for last mile trips to access train stations generating a positive impact on regional mobility because the core city doesn't receive anymore the same automobile volume.

After reviewing all factors and the most relevant variables, findings show that safety is a transversal aspect to all the classified factors, since the most important issue for users is to feel safe cycling. Thereupon cyclist infrastructure and public policy strategies to promote bicycles are the tools that planners have to create safe conditions to cycle and access train stations and reduce users' danger perception. Policy making must made from a user-oriented perspective to satisfy infrastructures and transit conditions requirements to invite those users with more restrictions to start commuting with BTI. For Latin American countries this is still a great challenge to overcome, but studies show the subject is booming interest between planners; which is a pretty good start.

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