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WHAT MOTIVATES SAO PAULO CITIZENS TO USE BICYCLES AS A MODE OF TRANSPORTATION? A STUDY IN THE LIGHT OF THE GOAL-FRAMING THEORY

O QUE MOTIVA OS PAULISTANOS A USAREM A BICICLETA COMO MEIO DE TRANSPORTE? UM ESTUDO À LUZ DA TEORIA DO GOAL FRAMING

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Felipe Fedrigo Foltram[1]
Paula Sarita Bigio Schnaider[1]
Juliano Pelegrina[1]

1 Universidade de São Paulo, São Paulo, SP, Brazil

ABSTRACT

Purpose – What motivates Sao Paulo citizens to use bicycles as a mode of transportation? To answer this question, we conceptually rely on the Goal-Framing Theory (Lindenberg, 2000), which seeks to understand how individual choices are made, and exogeneous variables such as climate and temperature which might influence in this decision.
Design/methodology/approach – Empirically, we conduct a quantitative study, relying on primary data from 252 respondents and analyzed by means of logistic regression models, through which we obtained the likelihood of using bikes and the relative weights of each of the variables defined in our theoretical section.
Findings – What motivates Sao Paulo residents are not economic reasons, but rather normative (doing what is right) or hedonic (the pursuit of personal satisfaction) aspects. In other words, we demonstrate that cyclists make this choice to comply with a norm, seeking for benefits to the environment and directly or indirectly to society, as opposed to benefitting individually from this decision.
Practical implications – The research has implication for public policies.
Originality/value – The study is one of the first to empirically test the Goal Framing Theory (Lindenberg, 2000) and, as far as we could tell, the first to assess the motivations for the use of bicycles as a means of transportation in Brazil and in Latin America.

Keywords - Goal Framing, Motivation, Bycicles, Transportation, Logit

RESUMO

Purpose – O que motiva os paulistanos a usar a bicicleta como meio de transporte? Para responder a essa pergunta, nos baseamos conceitualmente com a Teoria do Goal-Framing (Lindenberg, 2000), que busca entender como as escolhas individuais são feitas; assim como as variáveis exógenas, como clima e temperatura, que podem influenciar nessa decisão.
Design/methodology/approach – Empiricamente, realizamos um estudo quantitativo, com base em dados primários de 252 respondentes e analisados por meio de modelos de regressão logística, a partir dos quais obtivemos a probabilidade de uso de bicicletas e os pesos relativos de cada uma das variáveis definidas em nossa seção teórica.
Findings – O que motiva os paulistanos não são razões econômicas, mas sim aspectos normativos (fazer o que é certo) ou hedônicos (busca da satisfação pessoal). Em outras palavras, demonstramos que os ciclistas fazem essa escolha pelo cumprimento de uma norma, buscando benefícios ao meio ambiente e direta ou indiretamente à sociedade, ao invés de se beneficiarem individualmente dessa decisão.
Practical implications – A pesquisa tem implicações para as políticas públicas.
Originality/value – O estudo é um dos primeiros a testar empiricamente a Teoria do Goal Framing (Lindenberg, 2000) e, até onde pudemos dizer, o primeiro a avaliar as motivações para o uso da bicicleta como meio de transporte no Brasil e na América Latina.

Keywords - Goal Framing, Motivação, Bicicletas, Transporte, Logit

1 INTRODUCTION

European cities such as Copenhagen, Paris and Brussels have been progressively encouraging the use of bicycles as a mode of transportation (de Hartog et al., 2010), given the benefits brought by this practice to both the health of cyclists and the conservation of the environment. This is due reducing the levels of CO2 emissions caused by the burn of fossil fuel (Handy et al., 2014).

In order to develop strategies that promote greater adherence to the use of bicycles for transportation in large cities, it is crucial to identify the antecedents and the consequences of this choice (Gerike et al., 2019; Handy et al., 2014). After all, since different factors determine the choice of the means of transportation in urban areas, specific policies must be designed to encourage the use of bicycles in each case and situation (Mirzaei & Mignot, 2021). An extensive exploratory study conducted in Switzerland found three main motivations behind the use of bicycles as a vehicle for commuting to work: the wellbeing (hedonic), independence (utilitarian) and civic engagement (social and ecological) of users. Also, differences between individual socioeconomic characteristics and exogenous factors were shown to be significant in that same study (Rerat, 2019).

Despite the aforementioned advantages from the use of bicycles, the cycling infrastructure in the city of Sao Paulo (Brazil) still lags behind other cities such as Portland and Bogota (Monteiro & Naslavsky, 2018). In contrast, the number of cyclists in Sao Paulo and in Brazil in general has been undergoing constant growth, especially after the COVID-19 pandemic broke out (Vieira, 2021). This raises important questions about the reasons why, despite the afore-mentioned lack of infrastructure, Sao Paulo residents have been increasingly riding bicycles. Hence, the main question to be addressed in this study is: What motivates Sao Paulo residents to use bicycles as a mode of transportation? Answering this question can shed light on public policies targeted at encouraging this means of transportation.

To answer this question, this study will rely on the Goal-Framing Theory (Lindenberg, 2000), which seeks to understand how individual choices are made, going beyond the purely economic rationale. Also, in addition to the factors which are intrinsic to users, the theory incorporates exogenous elements that affect a given decision, in our case, the use of bicycles as a mode of transportation. After

all, “an adequate account of choice cannot ignore the effects of framing and context, even if they are normatively distasteful and mathematically intractable” (Tversky & Kahneman, 1986, p. S273).

Insights from the study conducted by Rerat (2019) have contributed to this first-ever application of the theory to explore motivations (hedonic, gain or normative) that emerge in individuals in each context, contributing to the choice of bicycles as a mode of transportation. Employing the theory in this manner serves to expand the volume of analyses of sustainable mobility models (Westin et al., 2020) and contributes to ending the scarcity of empirical studies that apply the theory outside corporate environments.

Thus, through a quantitative online survey conducted between December 2020 and January 2021, the study obtained 452 responses from people across all age and income ranges residing in all regions of Sao Paulo (both cyclists and non-cyclists). The results obtained from the logit regression model (Hair et al., 2014) demonstrate that, in general, what motivates Sao Paulo residents are not economic reasons, but rather normative (doing what is right) or even hedonic (the pursuit of personal satisfaction) aspects. These findings shed light on the potential paths policy makers can pursue to encourage the use of bicycles as a mode of transportation.

This study has been structured in four sections, in addition to this introduction. In the section that follows, we present a discussion of the intrinsic and exogenous motivational aspects that affect the use of bicycles as a mode of transportation. Next, we present our methodological procedures and results. Finally, we conduct a critical discussion of our empirical findings and derive implications for both enriching the theory and improving public policies.

2 THEORETICAL FRAMEWORK

2.1 The Goal-framing Theory: How are choices made?

The theory initially proposed by Lindenberg (2000) arose in scrutiny of the Rational Choice Theory, as the latter is independent of the social context in which choices are made, and considers economic actors as individual profit-maximizing agents (Lindenberg, 2000; Lindenberg & Steg, 2007). It can also be said that the Goal-Framing Theory is referenced in Coleman (1988) and in Granovetter (1985), who cast doubt on purely economic motivations that fail to properly consider the context in which they are inserted.

Many studies have been developed based on this theory to explain motivational influences that emerge or result from social contexts (Lindenberg, 2006, 2007), corporate contexts (Foss & Lindenberg, 2012; Foss & Lindenberg, 2013; Lindenberg & Foss, 2011) or environmental contexts (Lindenberg & Steg, 2007; Lindenberg & Steg, 2013).

In Goal-Framing Theory, the social context is incorporated to acknowledge secondary motivations and take into account choices that exceed a purely economic rationale. Lindenberg bases his theory on selective attention (frames) as a way to guide which action to choose (goals). Thus, individual action is based on the moment and the environment it is taken. The theory assumes that individual choices are influenced by three main frames, which virtually encompass any potential sub-frames: the hedonic frame (guiding actions through pleasure and pain), the gain frame (stimulated by economic benefits and costs) and the normative frame (activated by social values and norms). This theory is important to understand the difference between the environment as a bicycle user perceives it and what is this user’s main motivation to use bicycles as a mode of transportation.

With respect to the frames themselves, Lindberg confers on them two main characteristics: porosity and salience (or strength) (Lindenberg, 2007). The former is related to how open an overarching frame is to the influence of other frames, that is, how susceptible are individuals who are motivated in a certain way to the encouragement from a concurring motivation. As for the latter, it is

related to the strength or intensity of each frame. Therefore, more porous frames, if dominant, are more easily affected by salient secondary frames (Lindenberg, 2006). In the coming sections, these frames are detailed and explained.

2.2 Hedonic frame

"Here the goal is to 'feel good' or to 'feel better.'" (Lindenberg, 2000). The hedonic is the most salient out of the three overarching frames. In this frame, individuals seek to increase their own wellbeing independently of external factors, whether by seeking to increase the intensity or the frequency of which is good for this individual, like personal pleasures, or to reduce the parameters of that which is unpleasant, like pain. The hedonic is also the most basic of the three frames from a human evolutionary perspective (Lindenberg, 2007).

In terms of strength, the hedonic frame is the strongest compared to the gain and normative frames, that is, the hedonic frame takes predominance over the others. Since what is at stake is an individual's satisfaction, the need to obtain or experience something more pleasant causes individuals to, at that moment, disregard monetary gain or something that is important to society, evoking in them a sensation of impatience associated with achieving this more basic goal (Lindenberg, 2007).

2.3 Gain frame

In this frame, the goal is to increase resources that are already available, whether monetary or otherwise; or to minimize the loss of such resources when a situation is already well established. Another sub-variation of this frame is wanting to increase the efficiency of a productive result, for example looking for a job that pays more while requiring the same amount of effort. Therefore, the goal here is to maximize resources.

The very idea surrounding this frame becomes clearer if we are to analyze its namesake. Since the goal is to "gain," this frame is much more strongly directed towards an individual's self-interests related to achieving goals that are "less instinctive" than in the hedonic frame, for example "money, time available, knowledge, skills, decision power, social influence and so on." (Lindenberg, 2001, p. 657).

In terms of time, this frame is focused on the medium term, while the hedonic is a short term frame (Lindenberg, 2007). Its salience is medium, and can be placed in between the hedonic frame (strong) and the normative frame (weak).

2.4 Normative frame

Out of the three most important frames in goal-framing theory, the normative frame, while being the weakest in terms of strength, is the most important from a collective and societal viewpoint (Lindenberg, 2007).

As established before, its weak salience is associated with its strongly perennial nature, that is, its effect is long-lasting, lingering longer than the stronger hedonic and gain frames (Lindenberg, 2006; Lindenberg & Steg, 2007).

The normative frame is also seen as a moral frame since it is intended to satisfy that which is right from a societal, collective perspective. (Lindenberg, 2006). This is a frame that, when brought to the forefront by an individual, is meant to comply with collective norms regardless of momentary personal gains or of an increase in resources in the short or medium run. Therefore, this frame can be said to be much more altruistic than the others (Lindenberg, 2006).

We could also consider that the key goal of the normative frame, compared to the gain frame, is not to increase one's personal resources, but rather to increase collective resources (Lindenberg, 2001). These norms are, most of the time, intrinsic to a given individual inserted in society as opposed to being norms that are common to all. Take for example a religion that has its own norms: if an individual judges these norms to be correct and this individual's actions are supported by a normative frame, then this individual will be supported by these norms.

2.5 The influence of the environment on the goal of using bicycles

The trigger for an individual's functionality variation, that is, what prompts a change in this individual's function and behavior, are his or her objectives and goals, which change according to the situation the individual finds him or herself in. This functional flexibility prepares people both for what the environment provides them with and for processing the "inputs" they receive (Lindenberg & Steg, 2013). Goals are directly related to frames in two ways: (a) they influence the strength of each frame, one in relation to the others, and (b) they influence the order of alternatives about decisions to be made (Lindenberg & Steg, 2013).

This is directly related to the guiding aspect of this paper: how strong the personal goals of Sao Paulo residents are and how much this steers and upholds their day-to-day motivations, activating different frames that lead to different choices of modes of transportation as a means of locomotion.

2.6 Exogenous factors that influence the use of bicycles

If on the one hand an individual has different intrinsic motivations to use a bicycle, on the other this individual is able to perceive exogenous factors that may or may not encourage her/him to use it. In this environment, the individual makes decisions to provide motivations that are maintained or grow stronger with contextual encouragement. This is the same principle that distinguishes goal-framing theory from rational choice theory: the context in which an individual is inserted is considered when making a decision.

Following is a discussion of the three groups of contextual factors that are relevant to the use of bicycles, namely: safety and infrastructure; weather; and route terrain and distance. These factors were defined based on bicycle ownership and use indicators as confirmed in the literature (Handy et al., 2010).

2.6.1 Safety and infrastructure for using bicycles

Safety in the use of bicycles for locomotion involves not only the issue of crime (mugging, stealing and robbery) but also accidents along a route. One way accidents can be prevented is by making good infrastructure available, for example bicycle-only lanes.

Many studies demonstrate that the main features of bike lanes (extent, separate car and bike lanes, good pavement condition) have a positive influence on the increased use of bicycles (Dill & Carr, 2003; Handy et al., 2010; Pucher et al., 2010), and also that mugging and stealing have a negative influence on the use of bicycles (Beck & Immers, 1994; Handy et al., 2010; Van Lierop et al., 2015).

2.6.2 Weather and its relation with the use of bicycles

Many different studies show that there is a direct relation between local weather and the use of bicycles (Flynn et al., 2012; Handy et al., 2010; Nankervis, 1998; Nosal & Miranda-Moreno, 2014; Verma et al., 2016). This relation is in a way connected to the issue of safety, but also very strongly associated with comfort when riding a bicycle.

Rain is an important factor when deciding whether to use a bicycle as a mode of transportation, especially among those cyclists who do not often ride bicycles to work (Brandenburg et al., 2007). Nevertheless, the same study shows that, for cyclists who ride bikes more frequently, temperature is more relevant to their decision process than rain. This is because cyclists are already prepared for the rain, whereas extreme temperatures make the trip much more uncomfortable and, in the country where the study was conducted, extreme temperatures, especially during winter, are associated with snow.

2.6.3 Route terrain and distance and their relation with bicycles

Some studies address terrain as a relevant factor when deciding to use bicycles (Cole-Hunter et al., 2015; Dill & Carr, 2003; Handy et al., 2014). In practice, it is a known fact that no cyclist would overlook terrain when planning a route or even when deciding to use a bike. Cole-Hunter et al. (2015) showed that elevation is an aspect that negatively affects the decision of riding a bike to work, especially for non-users. The main reason is the fact that it requires much more physical effort. Another reason the authors assessed was lengthier trips, since cyclists would tend to look for flatter routes, even if greater in extent.

The longer the distance of a route, the less motivated non-bicycle users are to choose them as a mode of transportation (Cole-Hunter et al., 2015; Pucher et al., 2010). Beck & Immers (1994) reached the same conclusion in the city of Amsterdam, showing that, among the many reasons for not using a bicycle, “it is too far to cycle” was chief among them.

Therefore, the distance traveled by individuals in their daily routes is a factor that should affect their motivation regarding the use of bicycles as a mode of transportation in an inversely proportion manner, that is, the shorter the distance, the bigger the motivation to choose the two wheels.

2.7 Exogenous factors in the city of Sao Paulo

Considering the literature review that was conducted and examining the characteristics of terrain, weather, temperature and infrastructure in the city of Sao Paulo, the results listed in Table 1 are expected to reflect the presumed meaning of the influence of exogenous factors on the use of bicycles as a mode of transportation. Worth noting is that the present study evaluates the perceptions of users regarding these variables and that, while some of these coincide for most cyclists in Sao Paulo, each cyclist perceives them distinctively and gives different weights (or even meanings) to these influences. The relations described in Table 1 therefore served only as a reference of the meaning that the analyzed factors were expected to have.

Table 1. Expected influence of exogenous factors on the use of bicycles

Variable	Incentive Direction	Articles indicating incentive direction
Infrastructure	+	Dill & Carr, 2003; Handy et al., 2010; Pucher et al., 2010
Crime/Infrastructure	-	Beck & Immers, 1994; Handy et al., 2010; Van Lierop et al., 2015
Temperature too hot	-	Dill & Carr, 2003 ; Flynn et Al (2011) ; Saneinejad et Al, 2011
Temperature too cold	-	Dill & Carr, 2003 ; Flynn et Al (2011) ; Saneinejad et Al, 2011
Rain	-	Heinen et Al, 2011 ; Saneinejad et Al, 2011 ; Flynn et Al (2011)
Excessive elevation (terrain)	-	Cole-Hunter et Al , 2015 ; Handy et Al, 2010 ; Dill & Carr, 2003
Flat routes (terrain)	+	Cole-Hunter et Al , 2015 ; Handy et Al, 2010 ; Dill & Carr, 2003
Long distances	-	Beck & Immers (1994) ; Cole-Hunter et Al (2015) ; Pucher J. et al. (2010)

3 METHODOLOGY

The research was developed by taking a quantitative approach based on primary data (Hair et al., 2014). Data was collected from a structured survey (Alreck et al., 1995) designed to investigate the personal characteristics of respondents, the influence of exogenous factors on respondents and finally the main motivation of individuals with respect to the means of transportation they commonly make use of.

Researchers took a random sampling approach (Yamane, 1967), though they did make use of convenient contacts to disclose and distribute the survey out to different types of groups. The medium used to promote and distribute the survey was the Internet and groups found on WhatsApp and on Facebook pages to reach economically-active residents from all regions of Sao Paulo who were or were not users of bicycles and bike lanes. The survey was kept in circulation on those media for approximately one month and obtained a total of 452 responses.

Moreover, these results were triangulated with secondary data available from public documents to evaluate sample representativeness (Yamane, 1967).

The survey was composed of 27 questions divided into three parts. The first part sought to understand the routine and habits of respondents, focusing mainly on how they move around Sao Paulo, the main mode of transportation they use and their motivations. This part included two assertive questions to gauge motivation levels for each of the three archetypes in goal-framing theory (hedonic, gain and normative). The second part sought to collect data on how users perceive the city of Sao Paulo with respect to bike lane availability, bike lane quality, infrastructure, safety, terrain and weather (i.e. in sum, about how they perceive Sao Paulo city's bike riding context). The last part was meant to learn more about respondents and their personal characteristics for mobility across the city, such as the distance of their routes and the regions they live and work in. In addition, there were questions about age, genre and monthly income to understand a bit more about respondents' profiles and social classes.

3.1 Pre-test

To validate the survey, a pre-test was administered and closely monitored and supervised

by the primary author of this study (Alreck et al., 1995). Five surveys were applied that focused on, in addition to the responses, obtaining feedback about how to formulate the questions and about any aspects that could have raised doubts or that could be improved when structuring the questions. This pre-test sought to include various different profiles to increase the variability of results and to evaluate how assertive the instrument was.

The responses that were obtained were considered in the group of all responses since minor changes were made to the way some questions were phrased, but this altered neither the type of responses nor how the question was interpreted and served only to make them clearer.

3.2 Sample

To make the sample more diverse and more accurately reflect population heterogeneity (Yamane, 1967), the survey was distributed on Facebook group pages and on WhatsApp groups consisting of different profiles of people residing in the city of Sao Paulo.

Responses encompassed all regions of the city of Sao Paulo, and all age ranges of the economically active population, including older individuals.

Respondents within these groups were selected randomly and on a completely voluntary basis. No rewards or giveaways were offered to respondents. This way, the responses count was 452.

3.2.1 Respondent profile

In terms of gender, respondent distribution was very close to the population as a whole, with males being slightly predominant. In Sao Paulo, women outnumber men slightly, accounting for 53% of the population aged 20 to 60 years (IBGE, 2021).

On the subject of income, the result showed that most respondents belong to the higher classes of the population, with 85% of them earning a monthly income of over BRL 4,000.00, which represents individuals from classes C, B and A. This is very close to the average salaries seen in the city of Sao Paulo in 2018, of 4.3 minimum wages (BRL 4,700.00), according to IBGE (2021). Additionally, it is worth noting that 80% of Sao Paulo households earned more than two minimum wages per month in 2018 (IBGE, 2021).

The survey included respondents aged between 16 and 65 years, though more than 60% of respondents were between 20 and 40 years old, most of them at 24. Nevertheless, approximately 35% of respondents were older than 40 years. This distribution is show in detail in the Figure 1 histogram.

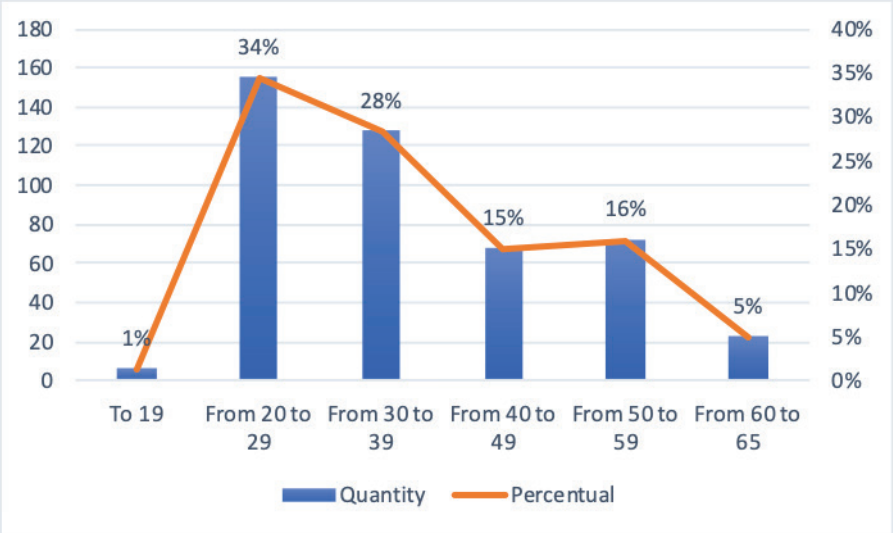

Figure 1. Respondent age distribution

For the purposes of comparison, according to the official 2010 government census by IBGE, 35% of the population residing in Sao Paulo are aged 40 or older, and a similar percentage is aged between 20 and 40 years. While the sample did manage to capture a percentage that is similar to the actual population in the over-40-years range, 20 to 40 year-olds were predominant in the study sample, especially 24 year-olds.

This could have had been due to the way the data was collected, but it does not invalidate the sample, given that the proportions between the different age groups were the same and because the greater variation was the result of children not being part of the sample.

Most of the survey respondents live in the South and West regions, accounting for nearly 75% of all respondents (Figure 2). As comparison, according to a 2015 DIEESE study on work and employment, 31% of workers in Sao Paulo lived in the South region and 7.6% in the West region.

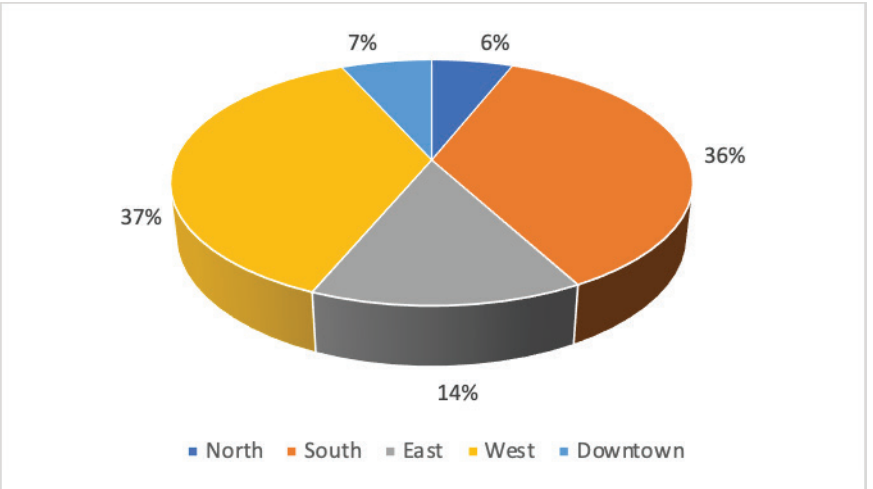

Figure 2. Respondent residence regions

While slightly different from the actual population universe, it is worth noting that the sample was able to capture the predominant West and South-bound trips seen in the actual population. On the other hand, most trips from the sample originate from these two regions, whereas most trips

made by the population in general originate in the East region. Nonetheless, since trip destinations are very close to each other, the sample can be considered to be an accurate representation. Note that the classification by region was self-declared by respondents and may be slightly different than that used by DIEESE.

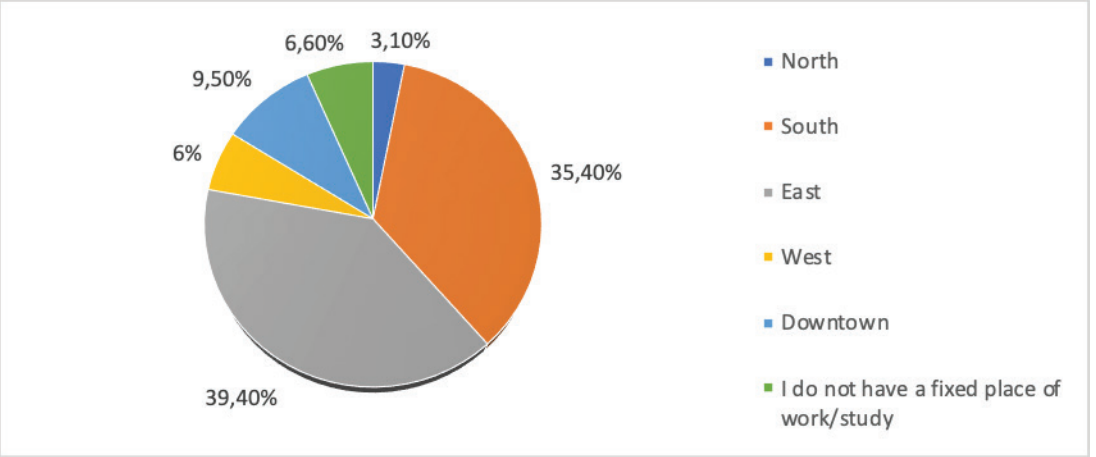

Figure 3. Respondent workplace region

Most respondents own at least one bicycle or use shared bicycles (62%). However, people who use bicycles as a mode of transportation do not make up the majority (only 6% of respondents use them).

Respondents travel on average 13 kilometers, considering the trip from home to work or from work to home; about 45 people travel more than 30 kilometers and more than 230 people travel fewer than 10 kilometers in a day. Figure 3 shows the distribution of the regions where respondents work or study in.

3.3 Model specification, variables and data analysis

This study used the logistic regression (logit) model (Hair et al., 2014) operated with Stata software. It sought to obtain an equation that would correlate the probability of people using a bicycle as their main mode of transportation as a function of their profile, motivation and exogenous factors from where the respondents live. The comprehensive list of these variables is shown in Table 2. The logistic function to be estimated is expressed by: $P(Y=1) = \frac{1}{1+e^{-(w \cdot x + b)}}$ where P(Y=1) denotes the probability of using the bicycle as a means of transportation, b is the intercept, x is a vector of independent variables influencing this decision (see Table 2) and w is a vector of weights (to be estimated) (Hair et al., 2014). We are particularly interested in determining which variables are significant, in which intensity and whether they influence positively or negatively in this decision.

The independent variables composing the vector x mentioned above were established based on the answers that measured each factor, and were assigned values of 1 to 4 for Likert scale-type questions (1 being “Strongly Disagree” and 4 being “Strongly Agree”) and of 0 and 1 for binary-type questions (for gender: 1 - “Male” and 0 - “Female”) (Alreck et al., 1995). The questions regarding age and distance traveled used, respectively, the values stated in the answer and the normalization using the value logarithm, for the purposes of reducing the effect of long tails and extremities (Alreck et al., 1995; Hair et al., 2014).

Questions that had distinct answers were turned into the dummy variable model, that is, they were tabulated and broken down in two columns, each one representing the three motivations

found in goal-framing theory: hedonic, gain and normative. Hence, if an answer was found to be associated with one of the motivations, this motivation would be given value 1 whereas the other two motivations would be valued 0, and so forth. Gain was assigned as baseline 0 0 (Hair et al., 2014). Table 2 describes each of the variables.

Table 2. Description of variables used in the models

Independent Variable	Description
Med_Mot_H	Median of Likert-scale responses about hedonic motivation
Med_Mot_E	Median of Likert-scale responses about gain motivation
Med_Mot_N	Median of Likert-scale responses about normative motivation
M_N3	Normative motivation as response to question about strongest motivation
M_H3	Hedonic motivation as response to question about strongest motivation
E_Rlv	Perception about terrain and feasibility to cycle in these conditions
R_Temp	Perception about extreme temperatures and feasibility to cycle in these conditions
E_Chuva	Perception about rain and feasibility to cycle in these conditions
E_Dist	Perception about distance traveled and feasibility to cycle in these conditions
E_Ciclo	Perception about bike lanes available in the route and feasibility to cycle in these conditions
E_RA	Perception about mugging and stealing and feasibility to cycle in these conditions
E_AcPes	Perception about accident safety and feasibility to cycle in these conditions
E_Conse	Perception about bike lane conservation and feasibility to cycle in these conditions
E_Vest	Perception about changing rooms available for cyclists and feasibility to cycle in these conditions
E_Bic	Perception about the presence of bike-parking and feasibility to cycle in these conditions
P_Bici	Owner or not owner of a bicycle (respondent)
P_Reg_Mora	Region where respondent lives
P_Reg_Trab	Region where respondent works or studies
P_Dist	Distance from respondent workplace or school to respondent home
P_Idade	Respondent age
P_Gen	Respondent gender
P_Renda	Respondent income range
P_Renda2	Separation of incomes over BRL10,000.00 (1) and below this amount (0)

Independent variable Y was obtained through question “What is the main mode of transportation you use?”, where the answer “Bicycle” was assigned value 1 and other answers were assigned value 0 (binary variable) (Hair et al., 2014).

4 ANALYSES

Four models were designed, all containing the variables related to motivational and exogenous factors and to profile. Included in each model were dummy variables or the income or high income variables (intended to evaluate the role of income in the study).

For each model, the pseudo R squared was calculated to show the percentage of the model which is explained by the variables included in it (Hair et al., 2014). Following this was an exploratory analysis of variable signs, looking for evidence of estimation problems. Last was a verification of the statistical significance of each variable and the magnitude of coefficients, in order to identify which variables had greater impact on the probability of a person using a bicycle as a mode of transportation.

Table 3 shows the results of the four models along with their respective Pseudo R squared and the coefficient for each variable in each model. This table will be discussed below.

Table 3. Model results

	Model I	Model II	Model III	Model IV
Pseudo R2	0,7677	0,7834	0,8392	0,8092
Variables	**Coef**	**Coef**	**Coef**	**Coef**
Med_Mot_H	1,42**	1,55*	1,76	1,68*
Med_Mot_E	-1,88	-2,18	-3,25	-2,59*
Med_Mot_N	3,92***	4,27***	7,15**	5,38***
M_N3	-	2,78*	2,69	3,89
M_H3	-	0,42	-1,00	0,01
E_Rlv	-1,43	-1,22	-0,96	-0,98
E_Temp	1,66	1,62	0,40	0,94
E_Chuva	1,50*	1,22	2,64*	1,79*
E_Dist	-0,89*	-0,86	-1,39	-1,09
E_Ciclo	-1,02	-1,17	-2,87*	-1,72*
E_RA	0,23	0,76	0,68	0,73
E_AcPes	1,12	0,98	2,99*	1,86*
E_Conse	0,45	0,35	0,36	0,12
E_Vest	-0,37	-0,59	0,47	-0,53
E_Bic	0,23	0,41	-0,25	0,42
P_Bici	5,45**	6,45**	9,34**	8,09**
P_Reg_Mora	-0,02	0,06	-0,05	0,14
P_Reg_Trab	-0,17	-0,22	-0,29	-0,14
P_Dist	1,95**	2,20**	3,39**	2,78**
P_Idade	-0,04	-0,06	0,01	-0,04
P_Gen	3,10**	3,46**	3,02	2,76
P_Renda	-	-	-2,57**	-
P_Renda2	-	-	-	-2,87*

Subtitle:
*** P < 0,1** **** P < 0,05** ***** P < 0,01**

Model I was intended to provide a first look of results and to confirm if any motivation would stand out from the others, as well as to analyze how exogenous variables and personal characteristics would be projected in the model.

It can be noted that normative motivation shows a significance level of 0.01, stronger than hedonic motivation (also significant, but at 0.05). Variable Med_Mot_E did not reach significance in this model and in none of the subsequent models. This indicates that although this variable should be incorporated in the models it does not influence in a statistically-significant manner the propensity to use a bicycle. Another aspect that must be highlighted is the meaning of the negative coefficient of this last variable. The proxy assumed for this motivation variable was the fact that the option if chosen was the cheapest one. Thus, a negative sign means that the more expensive this mode of transportation is, the less likely a bicycle will be chosen, as expected.

In relation to exogenous variables, few of them had statistical significance, and at a level of 0.10. These are: E_Chuva, stating that the chances of using a bicycle are greater among people who do not mind cycling in the rain (and not the rain per se); and E_Dist, which indicates that someone who considers the distance between their home and workplace infeasible is less likely to use a bicycle than someone who thinks this distance is feasible. Although not statistically significant, the other exogenous variables were kept in the model to prevent omitted-variable bias.

Concerning the control for respondent profile variables, these were shown to be statistically significant at 0.05: P_Bici, which indicates that people who own their own bicycle or use shared bicycles are more likely to use them as a mode of transportation than people who do not have access to bicycles; P_Dist, which indicates that the likelihood of a person using bicycles as a mode of transportation increases for each additional kilometer of distance between home and workplace; and finally P_Gen, which indicated that males are more likely to use bicycles as a mode of transportation than females. Even though variable P_Idade did not seem statistically relevant, its sign indicates that younger people are more likely to use bicycles as a mode of transportation.

Included in model II were variables M_H3 and M_N3. These variables were extracted from the most telling question about motivation and hence are expected to reinforce the information from model I, particularly with respect to motivation. The idea is to capture how much the chances of bicycles being used increase if the respondent's motivation is normative and hedonic as contrasted with those that are gain only (baseline 0 0).

In this second model, the pseudo R squared was increased, indicating that relevant information was included to explain the use of bicycles as a mode of transportation. It is interesting to note that the model reinforced the relevance of normative motivation as that which more strongly motivates Sao Paulo residents to use bicycles as a mode of transportation: not only did variable Med_Mot_N stay significant at 0.01, its coefficient grew even larger. Moreover, since dummy variable M_Mot_N was statistically significant, albeit at 0.10, it can be inferred that this variable is relevant compared to purely gain-related motivation.

Hedonic motivation once again was shown to be significant (at 0.10), although weaker than normative motivation based on the variable that represents the median of assertions (Med_Mot_H). However, this significance was not repeated in its dummy, added to the model (M_H3). This indicates that the probability of a respondent using a bicycle for hedonic reasons as opposed to gain reasons is not increased significantly, statistically speaking. Based on this analysis, it can be once again inferred that normative motivation has the strongest influence on the probability of a person using a bicycle as a mode of transportation.

With respect to exogenous variables, it is worth noting that none of them significant in this model. Nevertheless, the signs were shown to be consistent with the previous model, indicating the same direction. This reinforces the robustness of estimates.

Among the profile variables, the only one which remained as such were P_Bici and P_Gen, which grew a bit stronger in this model. At any rate, just as with exogenous variables, the signs of all profile control variables stayed the same, which once more provides an indication of how robust the estimates were.

In relation to model III, the variable related to respondents' income was initially left out of other models to prevent any kind of outcome bias. After all, it was assumed that, despite being independent, income could affect how relevant each motivation is. Therefore, including variable P_Renda shows that the previous result is improved (Pseudo R squared up from 0.7834 to 0.8392) without important trend changes. This indicates that we are including information that is relevant to the model.

Variable Med_Mot_N was observed to become the only significant motivation variable, representing a normative motivation that is much stronger than in the previous models. Variable P_Bici also increased in strength by approximately one third here (a coefficient that was already very high grew even higher). Other observations that can be made based on this model are the negative coefficient of P_Renda, indicating that the higher the income range, the lower the chances of an individual using a bicycle as a means of locomotion. This indicates that higher-income individuals end up choosing other transportation options.

Note that some exogenous factors show interesting results. Such is the case of E_Chuva, a variable that resumed being statistically significant in this model and became stronger than before. This means that respondents are so deeply involved in doing what they believe is right that they do not mind if they have to cycle in the rain.

Furthermore, variable E_Ciclo was shown to be statistically significant, albeit marginally so (at 0.10). This indicates that the chances of a person using a bicycle as a mode of transportation are lower for those people who realize a bike lane is available all the way from their homes to work than for those who fail to notice this. It can be inferred that this result is the consequence of the fact that the more people riding bicycles, more they will tend to notice that bike lanes are or are not available along their routes, and how much they are missed during everyday commuting. Note that this negative sign was shown to be consistent across all specifications, which reinforces the interpretation presented above.

Lastly, the analysis of model IV considered the impacts that incomes of upwards of BRL 10,000.00 had compared to the lower income group (baseline 0). As observed, by comparing the results from models III and IV, the model is not altered significantly. The difference was left to the significance of the three variables consisting of the medians of assertive questions related to motivation. Variable normative motivation (Med_Mot_N) remained as the strongest out of the three, though a bit weaker than in the previous model (coefficient was down from 7.14 to 5.38). The same was true for hedonic motivation variable (Med_Mot_H) (where the coefficient went from 1.76 down to 1.67), though this variable did acquire statistical significance, even if at 0.10.

A first seen here was variable economic motivation (Med_Mot_E), which appeared as negative and statistically significant for the first time, at just 0.10. This means that the more expensive a mode of transportation is, the lower the chances of this mode being bicycles. Despite these minor differences, what can be inferred is that just as in the other models, normative agents are those that are more likely to use bicycles as a mode of transportation regardless of their income.

4.1 Implications and discussion

As observed, the results demonstrate the importance of some motivations, of certain individual profiles and of specific exogenous factors for Sao Paulo residents to choose bicycles as a mode of transportation. According to Goal Framing Theory mentioned earlier, contextual factors, as well as intrinsic characteristics of the decision maker, play an essential role in guiding the type of motivation that will influence someone when making a particular choice. As we shall discuss with more detail in the coming sections, individuals choosing to ride a bicycle as a means of transportation in Sao Paulo are not economically motivated to use them, but rather, by normative values (socio or environmentally related) and/or pleasure (hedonic reasons). The strength and significance of these intrinsic frames stood out so much that exogenous factors influencing similar individuals in other cities, such as weather, infrastructure or even safety have shown no statistical significance in Sao Paulo, that is, play a minor role in this respect. In the coming section, a more explicit discussion of the influence of each of these factors is carried out.

4.1.1 Motivation variables

All models discussed in this paper indicate that normative motivation is the strongest and most important among the three. Its greatest contribution was obtained in model III, in which the coefficient for variable Med_Mot_N was 7.14, and in all of them this variable was shown to be statistically significant.

The fact that normative motivation is so much more intense and the only significant motivation out of the others, in the model that better explained the use of bicycles as alternative means of transportation (with the highest Pseudo R squared among all models: 0.8392), precisely when the variable income was taken into consideration, is a scientific fact deserving of attention in this study. It indicates, in a generalized manner for Sao Paulo citizens distributed across all income ranges, that the motivations that propel them to use bicycles as a mode of transportation are social wellbeing and conservation of the environment.

Hedonic motivation was shown to have an important albeit secondary role for the model, as represented by variable Med_Mot_H. It obtained statistical relevance in practically all models, and always with positive coefficients, even if they were not as high as those of normative motivation, but relevant nonetheless. Another thing worth noting is that the model where hedonic motivation was most intense was the high income model. This shows that individuals were not pushed solely by altruistic reasons, but also were shown to be more egocentric, motivated by personal pleasure and health.

With respect to economic motivation, it is noted that it bears no statistical significance in nearly all models, with a negative coefficient, indicating that the price of using a bicycle has no influence on the decision to cycle. Nonetheless, when combined with the other motivational variables, it might demonstrate that individuals would cycle to work even if having to invest more money to do so, because of the strength and significance of the hedonic (cycling for pleasure) and normative (contributing to the health of the community and to the environment as a whole) motivations. These results are counterintuitive and have theoretical implications because, as mentioned earlier, it is standard to assume that economic factors stand out when making choices, in a general way. Nonetheless, as our empirical analyses have revealed, this is not the case, as the economic frame plays almost no role in this decision and when it does, it is negative. This could mistakenly lead us to believe the individuals would have no incentives to cycle, if they had to invest in buying or renting a bike for instance. As we have demonstrated, this is not the case because the other two frames have shown greater statistical significance and influence the decision to cycle in a positive way.

Also, as noted by the Goal Framing Theory, the influence of each of the frames varies both in terms of choosing to cycle now and through time. While the hedonic frame is the one that most influences the immediate decision, the normative frame is the most perennial one. Both have shown strong relevance in our results. This means that even if cyclists cease to find pleasure in riding, they should still do so because of normative aspects.

A practical implication of our findings is in respect to public policies. As we have shown, economic incentives may not be the best alternative to encourage the use of bicycles as a mode of transportation. Instead, it would be best to have actions that demonstrate how bicycles can contribute to conserve the environment, improve social wellness and to improve cyclists' health and satisfaction.

4.1.2 Exogenous variables

Despite bearing little statistical significance, these variables have displayed a consistent behavior over the course of the study.

Highlights are infrastructure and rain, since the results for terrain and distance fell within expectations. In relation to rain, it was noted that regular cyclists already prepare for that and tend to ride their bicycles even in rainy days. As to infrastructure, the study demonstrates that bike lanes are potentially lacking in the city in terms of extent and quality. Nonetheless, because of their intrinsic motivations, cyclists still choose to ride their bikes, despite these shortcomings.

4.1.3 Respondent profile variables

As expected, variable P_Bici is the strongest variable in the model, as not having access to a bicycle would certainly prevent a person from using it.

In terms of gender, males show a stronger tendency to use bicycles. This raises a hypothesis about the issue, whether that women feel unsafe or that females are vain and unwilling to go through the hoops that using a bicycle entails. Respondent age did not show any relevant results.

5 CONCLUSION

In view of the situation experienced over 2020 and so far into 2021, there was a large increase in the number of bicycles circulating around the city of Sao Paulo. The main goal of this paper was to identify the behavior of Sao Paulo residents in relation to this mode of transportation in an attempt to find, fundamentally, what are their main motivations and which physical, weather and social aspects encourage cyclists to ride a bike frequently from their homes to work or school. One aspect worth of note is that this is one of the first studies that applied goal-framing theory to this specific context of using bicycles as a mode of transportation.

The study has made important discoveries in regard to the prototypical motivations put forward by Lindenberg (2000) investigated in the context of the use of bicycles as a mode of transportation in the city of Sao Paulo. Contrary to expectations, the normative frame was shown to be the primary force, demonstrating that an individual will choose to use bicycles to comply with a norm, looking for bringing benefits to the environment and directly or indirectly to society, as opposed to benefitting individually from this decision. This conclusion can be impacted to a degree by a sample bias, as the sample may not be representative of class behavior as a whole. Nevertheless, it is a significant result that escapes the gain spectrum. The hedonic frame was also significant in the study, demonstrating that personal wellbeing takes a backseat in this choice. Considering the current moment of the COVID-19 pandemic, the fact that the hedonic frame was shown to be strong, even if secondary, suggests that individuals seek moments of pleasure (or of pain relief) when they use bicycles. This demonstrates that more people could be looking for bicycles as a way to improve their wellbeing at a time in which people are isolated inside their homes due to the pandemic.

Therefore, these findings about the application of goal-framing theory combined with exogenous factors provide insights that can be made use of in public policies that encourage the use of bicycles. This paper shows that financial incentives, so often proposed, including in European countries, do not serve necessarily as motivation for people to continuously use bicycles as a mode of transportation. On the other hand, incentives intended to increase awareness about the environment, traffic education programs and improved overall infrastructure all tend to bring about effects that exceed expectations.

Future studies could experimentally evaluate the results of the application of specific incentives to the use of bicycles in Sao Paulo. The combination of normative and utilitarian (convenience or monetary compensation) incentives is something that could be tested in Sao Paulo. A recent study by Westin et al. (2020), for example, used goal-framing to test the development of public policies that discourage the use of automobiles in major cities of Sweden.

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AUTHORS

1. Felipe Fedrigo Foltram
Institution / Affiliation: Universidade de São Paulo, São Paulo, SP, Brazil
Biography Summary: Bachelor in Business Administration – FEAUSP
E-mail: fffoltram@gmail.com
ORCID: https://orcid.org/0000-0002-8514-1464

2. Paula Sarita Bigio Schnaider
Institution/Affiliation: Universidade de São Paulo. São Paulo, SP, Brazil
Biography Summary: Professor at FEAUSP. PhD in Economics (University of Paris 1- Panthéon-Sorbonne) and in Business (FEA-USP).
E-mail: paula.schnaider@usp.br
ORCID: https://orcid.org/0000-0001-5798-0343

3. Juliano Pelegrina
Institution / Affiliation: Universidade de São Paulo. São Paulo, SP, Brazil
Biography Summary: PhD candidate and MSc. in Business – FEA-USP, Mechanical Engineer – Sao Paulo State University (UNESP)
E-mail: jpelegri@hotmail.com
ORCID (Required of all authors): https://orcid.org/0000-0001-9955-5396

Contribution of authors

Contribution	[Author 1]	[Author 2]	[Author 3]
1. Definition of research problem	√	√	√
2. Development of hypotheses or research questions (empirical studies)	√	√	√
3. Development of theoretical propositions (theoretical work)	√	√	√
4. Theoretical foundation / Literature review	√	√	√
5. Definition of methodological procedures	√	√	√
6. Data collection	√		
7. Statistical analysis	√	√	√
8. Analysis and interpretation of data	√	√	√
9. Critical revision of the manuscript	√	√	√
10. Manuscript writing	√	√	√
11. Other (please specify)			

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