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Female Consumption Drivers Associated with Ride-Hailing in Brazilian Capitals

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Impulsores de Consumo Femenino Asociados con Ride-Hailing en Capitales Brasileñas
Direcionadores de Consumo Feminino Associados ao Ride-Hailing em Capitais Brasileiras

AUTHORS

Violin, Fábio Luciano[1]
State University of São Paulo, Brazil
fabio.violin@unesp.br

Zorzi, Mariciana
Universidad de la República (UDELAR), Área de Estudos Turísticos, Centro Universitario Regional Este (CURE)
mari.zorzi@gmail.com

Arizaga, Hugo Ferreira
Cenur Litoral Norte Sede Salto. Universidad de la República (Uruguay)
hhferre@vera.com.uy

Gouveia, Luiz Borges
Universidade Fernando Pessoa, Brazil
lmbg@ufp.edu.pt

1. Corresponding autor: Avenida dos Barrageiros, 1881. Primavera – Rosana – São Paulo, Brazil

The study proposed an explanatory model of female consumption behavior associated with ride-hailing in Brazil. 2176 interviews were carried out in representative capitals of the five regions of the country, allowing to point out that the use takes place in a utilitarian way with support provided by technological facilitators, evidencing the concern of women with physical and/or psychological violence. The results represent a theoretical advance by revealing the commutability of variables according to the reasons for use and the period of travel, which change the order and degree of importance of the decision-making inductors, indicating that in leisure situations or social obligations in the night, increases the level of relevance of variables related to forms of harassment and self-preservation. Interchangeable behavior is formed by the perception of influence variables associated with reasons for use and time of day and represents a distinctive understanding in understanding the topic.

El estudio propuso un modelo explicativo del comportamiento de consumo femenino asociado con el transporte compartido en Brasil. Se realizaron 2176 entrevistas en capitales representativas de las cinco regiones del país, lo que permitió señalar que el uso se da de forma utilitaria con apoyo de facilitadores tecnológicos, evidenciando la preocupación de las mujeres con la violencia física y/o psicológica. Los resultados representan un avance teórico al revelar la conmutabilidad de variables según los motivos de uso y el período de viaje, que modifican el orden y grado de importancia de los inductores de la toma de decisiones, indicando que en situaciones de ocio u obligaciones sociales en la noche, aumenta el nivel de relevancia de las variables relacionadas con las formas de acoso y autoconservación. El comportamiento intercambiable está formado por la percepción de variables de influencia asociadas con los motivos de uso y la hora del día y representa una comprensión distintiva en la comprensión del tema.

O estudo propôs modelo explicativo do comportamento de consumo feminino associado ao ride-hailing no Brasil. Foram realizadas 2176 entrevistas em capitais representativas das cinco regiões do país, permitindo apontar que o uso se dá de forma utilitária com apoio de facilitadores tecnológicos, evidenciando a preocupação das mulheres com a violência física e/ou psicológica. Os resultados representam um avanço teórico ao revelar a comutabilidade das variáveis de acordo com os motivos de uso e o período da viagem, que alteram a ordem e o grau de importância dos indutores de tomada de decisão, indicando que em situações de lazer ou obrigações sociais na noite, aumenta o nível de relevância das variáveis relacionadas às formas de assédio e autopreservação. O comportamento intercambiável é formado pela percepção de variáveis de influência associadas aos motivos de uso e horário do dia e representa um entendimento diferenciado na compreensão do tema.

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1. Introduction

Ride-hailing can be understood as an on-demand means of commuting based on a platform or mobile device application that connects drivers and passengers (Violin, 2020) and represents an important phenomenon of the modern mobility industry considering its expansion and scope, transforming the form of supply in the places where it is inserted, notably from the proliferation of access platforms, popularization of smartphones and Internet 2.0 (Violin, 2021a), generating a substantial volume of new companies operating in the segment, such as Lady Driver, Femi Taxi, Blablacar Só para Elas, among others (Microsoft Store, 2022).

Recently, the body of research has increased, highlighting the social, environmental, economic and technological dimensions as guidelines for the decision-making process to use the service (Lavieri; Bhat, 2019), however, in Brazil, research they still have a small volume, often having only one location or a restricted audience as an object of analysis, and an even smaller number of studies related to female consumption behavior.

It is essential to specify that this study is based on the analysis of influence variables related to female consumption behavior in the context of ride-hailing, without intending to address issues of a historical, sociological, anthropological nature or even gender differences.

The propensity of the population to avail of ride-hailing services stands out, whether in developed (Lavieri ; Bhat, 2019) or developing countries (Moody *et al.*, 2021), indicating that it is a world-class phenomenon, however, a limitation to be overcome is centered on the fact that a substantial part of the studies present only descriptive factors in their context of analysis, not establishing correlations with elements underlying the decision-making process to consume the service, such as the motivators of use - Work, Leisure, Social Obligations and Distinct Responsibilities - (Soto Villagrán, 2019) associated with periods of travel (morning, afternoon, night and dawn), pointing to a gap to be filled.

The generation of an Exploratory and Confirmatory Factor Analysis model with subsequent Principal Component Analysis allows comparison of the results with robust studies carried out, for example, in Spain (Aguilera-García *et al.* , 2022); Mexico (Moody *et al.*, 2021); United States (LaValle, 2020); Chile (Lagos, 2019); Brazil (Colodetti; Melo, 2020); China (Liu *et al.*, 2022); Peru (Martinez *et al.*, 2018) among others, signaling progress in the field of theory by revealing the inducers of female consumption.

Additionally, the set of notes allows replication in studies that deal with the same theme, being able to assist in the understanding of discussions in adjacent areas, for example, the regulation of the activity, its impacts on cities (Costa *et al.*, 2021), comparison with other modes of displacement (Lavieri; Bhat, 2019), public security policies and / or private (Colodetti; Melo, 2020) and even in the work relationships (Bezerra, 2021) underlying the service offer.

Keywords
Ride-hailing; On-demand displacement; Technology, Female consumer behavior.

Palabras clave
Transporte compartido; Desplazamiento bajo demanda, Tecnología, Comportamiento del consumidor femenino.

Palavras-chave
Ride-hailing; Deslocamento sob demanda; Tecnologia, Comportamento do consumidor feminino.

JEL Codes
O18; D16, R11

Thus, a literature review was carried out, including a survey of the state of the art nationally and internationally, to propose an explanatory model whose results were compared with robust studies related to female consumption behavior.

2. Ride-hailing

The ride-hailing industry has gone from a niche market to a level of technological disruption (Agarwal *et al.*, 2022) with around US$60 billion in revenue in 2017, with a tendency to reach US$285 billion by 2030 (Huston, 2017).

In 2017, around 3% of the kilometers traveled in urban trips around the world were carried out using the ride-hailing format, with an estimate of an accelerated increase, tending to 18% by 2035, with a probability of reaching levels above 30% in cities large scale, indicating that this is a global phenomenon with a potential for accelerated expansion (Soto Villagrán, 2019; Liu *et al.*, 2022).

Ride-hailing is synonymous with urban trips carried out in private cars using technology and represents one of the most relevant phenomena of mobility in the 21st century, considering the increase in connectivity, the massification of smartphones and the structuring of digital platforms for access to this type of service (Nourani *et al.*, 2020; Costa *et al.*, 2021).

Table 1 indicates the most common lines of research related to the study of ride-hailing today, without considering the issue of gender-based use.

Table 1. - Ride-hailing Research Concentration Areas

Author(s)	*Results*
Agarwal *et al.*, 2022	Price impacts on consumption perception.
Liu *et al.*, 2022	Risk perception and impacts on the safety association.
Aguilera-García *et al.*, 2022	From a behavioral point of view, people are more open to technological innovation and favorable to market opening.
Rangel *et al.*, 2021	Association of tariffs with different explanatory variables.
Violin, 2021a	Ride-hailing associated with cost, personal benefits and technological enablers.
Violin, 2020	Ride-hailing promotes cost and time reduction compared to conventional taxis.
Mourad *et al.*, 2019	Impact of the mechanism on the efficiency of the on-demand transport system.
Moody *et al.*, 2021	Review of different variants of shared mobility systems.

The results refer to technological environments, environmental and efficient aspects, the behavior of cities, among other points of confluence that increase the volume of understanding and importance of the theme.

In this way, it is up to open a discussion about possible disparities and similarities between the influence variables related to the general public and women, specifically ride-hailing associated with female consumption.

2.1. Women and Ride-hailing

The literature indicates that women tend to undertake more commuting trips considering the dynamics of their attributions, which go beyond going to work, and may involve aspects related to family care, social obligations or different responsibilities (Soto Villagrán, 2019; Sabogal- Cardona *et al.*, 2021).

Socioeconomic conditions and social norms can generate differences in commuting behavior between men and women, such differences are more pronounced in developing countries given the multiplicity of responsibilities assigned to women (Sabogal-Cardona *et al.*, 2021).

Such modalities in Latin America generally do not have security mechanisms capable of preventing possible crimes, with few exceptions (World Bank Group; UFGE, 2020), and may present events of harassment and sexual assault (FIA Foundation; CAF, 2017).

It is observed that the need for agile displacements and with lower barriers of time and place of boarding provided by the ride (Violin, 2021b) can be an important inducer of use. Considering the multiplicity of variables, **Table 2** was created, which presents international studies related to the topic:

Table 2. - Drivers of female use related to ride-hailing

Authors	*Recommendation*	*Factor*
FIA Foundation; CAF, 2017	Assault and sexual harassment.	Physical and Psychological Safety
IFC. 2018; World Bank Group, UFGE, 2020	Need to work close to home or with easy displacement.	Reduced barriers in time and place of embarkation.
Lavieri; Bhat, 2019	Men have higher levels of search attitudes for a variety of modes of travel.	Variety and Search Attitude
Lagos *et al.*, 2019	Fatal traffic accidents due to drunk driving and fatalities.	Risk to life associated with fatalities and drunkenness.
Martinez *et al.*, 2018	Facilitators of female access to work.	Travel time savings and increased security
Shi *et al.*, 2021	Influence of travel frequency and structure and choice of travel mode.	Improved supply conditions can be an attraction element.

The volume of international studies related to the subject is still recent and small, however, the number of women users of this type of modal has grown (World Bank Group, UFGE, 2020; Shi *et al.*, 2021) consistently and presents itself as a robust segment and in need of broadening the understanding of its operating dynamics.

If internationally the topic begins to gain expression and volume of discussion, in Brazil, studies are still restricted and of small scope for the most part, as shown in **Table 3**:

Table 3. - Female Ride-Hailing in Brazil

Author(s)	*Appointments*	*Sample*	*Focus on women*
Miranda, 2020	Use based on trust, price, quality and socialization	22 women	Partial
Costa *et al.*, 2021	Price is the predominant usage factor.	312 women	Partial
Nourani *et al.*, 2020	Safety is a distinctive element of ride-hailing use by women.	211 women	Partial
Bezerra, 2021	Precarious work of female drivers	215 women	Yes
Colodetti; Melo, 2020	Female insertion as a conductor and her social and cultural role.	11 women	Yes

Considering the above, the hypothesis is pointed out that female consumption is determined by variables similar to those of the general public - such as cost, interests in use (expectation of benefits) and technology-based facilitators (time, boarding) - (Rangel *et al.*, 2021; Agarwal *et al.*, 2022) added with elements aimed at self-preservation, such as forms of harassment and risk of life (Colodetti; Melo, 2020; Shi *et al.*, 2021; Bezerra, 2021) impacted by the reason for use (Soto Villagrán, 2019) and the periods of the day when users use the service (Violin, 2021a).

3. Methodological Procedures

The structure of the study made use of three probabilistic procedures that guided the sample size, the sampling points, the delimitation, and equation of the target audience, the periods, times, and form of collection, among other aspects inherent to the data collection.

The first action was to determine the population of interest, excluding extraneous elements (Yong; Pearce, 2013) through the precepts of the sampling grid, it was determined that the sample would be formed by women, over 18 years old, approached in places of Ride-hailing offer boarding with service usage attitude (cell phone in hands, insistent observation of cars approaching the location and constant consultation on smartphone, in addition to women disembarking from vehicles with service identification).

Subsequently, systematic sampling was used, which proclaims the emergence of obtaining the largest number of sample subjects with the possibility of harmonious participation (Matos; Rodrigues, 2019) and in this way it was determined that the third sample subject would be approached at each shift identification for the interview.

The study also used cluster sampling, which determines the main places where events occur as a way of establishing the sample size. We used the measurement of the flow of shipments at each sampling point (hotels, malls, events, universities and colleges, bus station, airport and public fair) for one hour in three periods (morning, afternoon, and evening) in São Paulo, Florianópolis, Campo Grande and Salvador (pre-test sites) between January and March 2021.

The choice of capitals was due to the greater volume of offers and sampling points. Approximately 18 shipments/hour were measured, with data collection for one hour at each sampling point. In this way, 128 interviews were collected per municipality, generating a total of 2176 valid interviews (including pre-test), whose averages stabilized between the 109th and 116th sample subject and took place between May 2021 and March 2022, as observed. if in **chart I**:

Chart 1. - Sample description

Region	*Capitals*	*Number of interviewees*	*Accumulated from interviews*	*Average of data normalization*
North	Manaus, Belém, Palmas	384	384	109th
North East	Salvador, Fortaleza, Recife, Aracaju	512	896	112th
South	Curitiba, Florianópolis, Porto Alegre	384	1280	116th
Southeast	São Paulo, Rio de Janeiro, Belo Horizonte	384	1664	115th
Midwest	Campo Grande, Cuiabá, Goiânia	384	2048	110th
Federal District	Brasília	128	2176	111th

To assemble the data collection instrument, we used a set of authors who dealt with inducers of use of ride-hailing services added to studies of the same nature, aimed at the female audience, as shown in **table 4**.

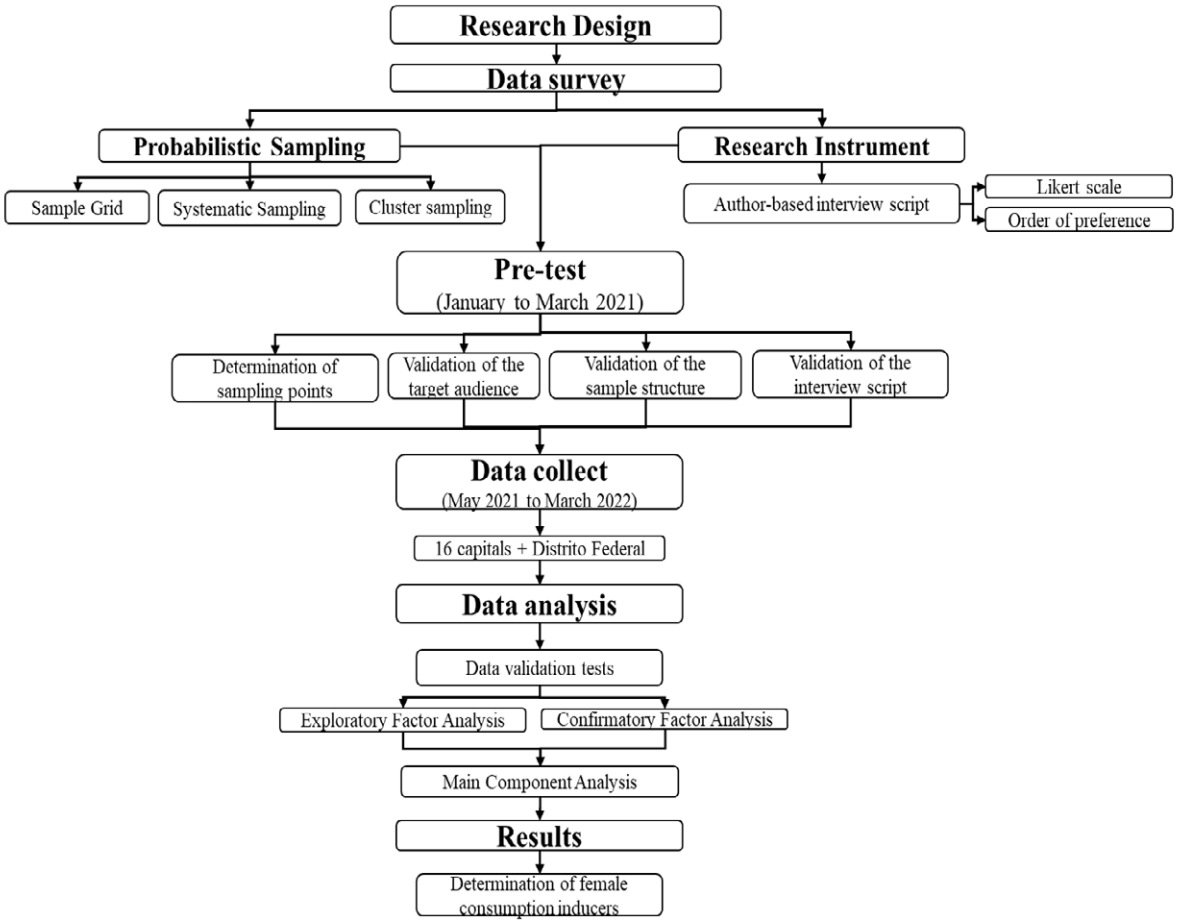
Table 4. - Research delineating variables

Authors	*Factors*	*General Public*	*Public Female*	*Nature*
Geissinger *et al.*, 2020	Reduction of Pollutants			Environmental
	Vehicle Reduction			Environmental
FIA Foundation; CAF, 2017; Martinez *et al.*, 2018; Nourani *et al.*, 2020	Physical Security			Social
	Psychological Safety			Social
IFC. 2018; Martinez *et al.*, 2018; World Bank Group, UFGE, 2020; Violin 2021b	Technological Availability			Technological
	Boarding Convenience			Technological
	Time Convenience			Technological
Lagos *et al.*, 2019	Risk Reducer (drunkenness, fatalities)			Social
Violin, 2021b	Data Security			Technological
	Expectation of Benefits			Social
Miranda, 2020; Violin 2020; Costa *et al.*, 2021; Aguilera-García *et al.*, 2022	Service Quality			Economic
	Trust in Service			Technological
	Reduced Price			Economic
	Socialization			Social

The set of authors cited in the body of **table 4** is representative of the most common influence variables found in the literature related to the topic and served as the basis for the assembly of the research instrument.

To determine the explanatory model, Exploratory Factor Analysis was first used to validate the variables. Subsequently, the use inducers with greater adherence were submitted to Confirmatory Factor Analysis. In the end, the data were treated based on the principles of Principal Component Analysis. **Figure 1** illustrates the methodological path:

Figure 1. - Outline of research procedures



As data validation parameters, the KMO and Bartlett test were generated, which present the consistency and reliability indicators, expressed in **table 5**:

Table 5. - KMO and Bartlett Test

Kaiser-Meyer-Olkin measure of sample adequacy		,908
Bartlett's sphericity test	Approximate chi-square (x^2).	19442, 489
	df	90
	Sig.	,000

Both the Kaiser-Meyer-Olkin measure ≥ 0.80 and the Bartlett test for sphericity have adequate significance (≤ .005), indicating consistency and reliability of the data (Matos; Rodrigues, 2019).

4. Analysis and Discussion of Results

As a way of legitimizing the set of variables, the data were initially measured from the Exploratory Factor Analysis shown in **table 6**:

Table 6 - Total Variation Explained

Components	Initial Eigenvalues			Sum of square loading extractions		
	Total	% Variance	Cumulative %	Total	% Variance	Cumulative %
1	12,983	81,146	81,146	12,983	81,146	81,146
2	1,556	9,727	90,873	1,556	9,727	90,873
3	1,037	6,484	97,358	1,037	6,484	97,358
4	,200	1,250	98,607			
5	,084	,524	99,132			
6	,076	,284	99,891			
7	,045	,109	100,000			

Extraction method: Principal component analysis.

The data indicate that the set of variables explains 97.36% of the reasons for use of ride-hailing by women in Brazilian capitals through three sets of factors, considering the prerogative of ≥ .60 (Matos; Rodrigues, 2019). **Table 7** indicates the setting of variables:

Table 7 - Commonalities, component matrix and allocation factor

Indicators	Reduced Price	Expectation of Benefits	Technological Availability	Boarding Convenience	Time Convenience	Risk Reducer	Physical Safety	Psychological Safety	Socialization	Reduction of Pollutants	Vehicle Reduction	Trust in Service	Data Security	Service Quality
Commonalities	,742	,755	,801	,722	,744	,844	,789	,799	,837	,212	,195	,333	,428	,284
Factor Matrix [a]	,895	,814	,866	,872	,847	,881	,892	,877	,523	,474	,397	298	417	468
Factor [b]	1	1	1	1	1	2	2	2	3	3	3	3	3	3

Note: [a] Rotation method: Varimax / [b] factorial categorization to which the variable belongs.

The values expressed in the communalities field (≥ .500) plus the Factor Matrix with indicators ≥ .60 indicate the reliability of part of the variables, supported by the prerogative of percentage of variance above 60% (**Table 6**) attest to the reliability of the data (Yong; Pearce, 2013).

After validating the variables, the data were submitted to Confirmatory Factor Analysis to generate a model. **Table 8** presents Model 1 composed of fourteen measured variables and the Modified Model presents nine variables that fit the explanatory proposal, namely: Expectation of Benefits; Time Convenience; Boarding Amenity; Technological Availability; Psychological Safety; Physical security; Socialization; Risk Reduction and Reduced Price.

Table 8. - Comparative data between models - Confirmatory Factor Analysis

	Absolute fit measures		*Incremental fit measures*			*Parsimony-adjusted measures*			
Models	*Chi-square (x^2)*	*RMSEA*	*CFI*	*TLI*	*NFI*	*PRATIO*	*PCFI*	*PNFI*	*AIC*
Model 1	0,000	0,241	0,614	0,657	0,622	0,700	0,524	0,504	5744,432
Modified Model	0,0087	,0059	0,919	0,918	0,911	0,859	0,749	0,766	2975,871

Model 1 presented indicators of inadequacy according to the prerogatives expressed in the literature (Matos; Rodrigues, 2019).

The Modified Model presented verisimilitude expressed by $x^2 \geq 0.0$, indicating that the distance between the observed data matrix and the estimated matrix is appropriate (Matos; Rodrigues, 2019). The RMSEA generated an index ≤ 0.060, considered relevant and the incremental adjustment measures (CFI, TLI and NFI) presented indexes ≥ 0.90 (Yong; Pearce, 2013).

The parsimonious indices (PRATIO, PCFI and PNFI) indicated values ≥ 0.50, considered parsimonious (Yong; Pearce, 2013), and the values expressed by the AIC measure the consistency of the Modified Model, being considered consistent (Matos; Rodrigues, 2019). In the second stage in the analysis of the confirmatory factors, the set of indicators presented sequentially in **table 9** was contextualized:

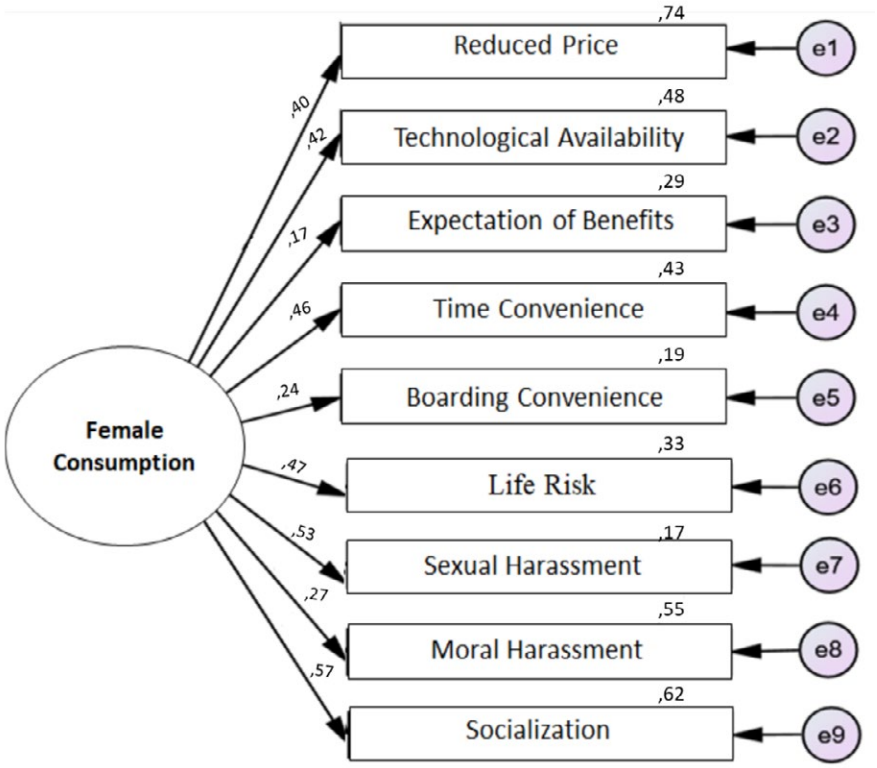
Table 9. - Regression weights, variations and intercepts

Variables	*Standardized Weights*	*Variation Regression*	*Weight of Multiple Square*	*Correlation Regressions*
Reduced Price	***	***	,722	,317
Time Convenience	***	***	,456	,288
Life risk	***	***	,577	,712
Boarding Convenience	***	***	,774	,518
Physical Security	***	***	,709	,742
psychological safety	***	***	,799	,442
Technological Availability	***	***	,339	,247
Socialization	***	***	,421	,485
Expectation of Benefits	***	***	,808	,544

The indicators expressed in **table 9** present values of $p < 0.01$ in the Regression Weights field, indicating adequacy. The dataset indicates the absence of multicollinearity, and the indicators of Regression, Variance, "Standardized Regression Weights" and "Multiple Squared Correlations" are consistent according to the literature (Field *et al.*, 2012).

From the data generated by the Amos software (IBM SPSS Statistics) the model generated in **Figure 2** stands out:

Figure 2. - Path Diagram

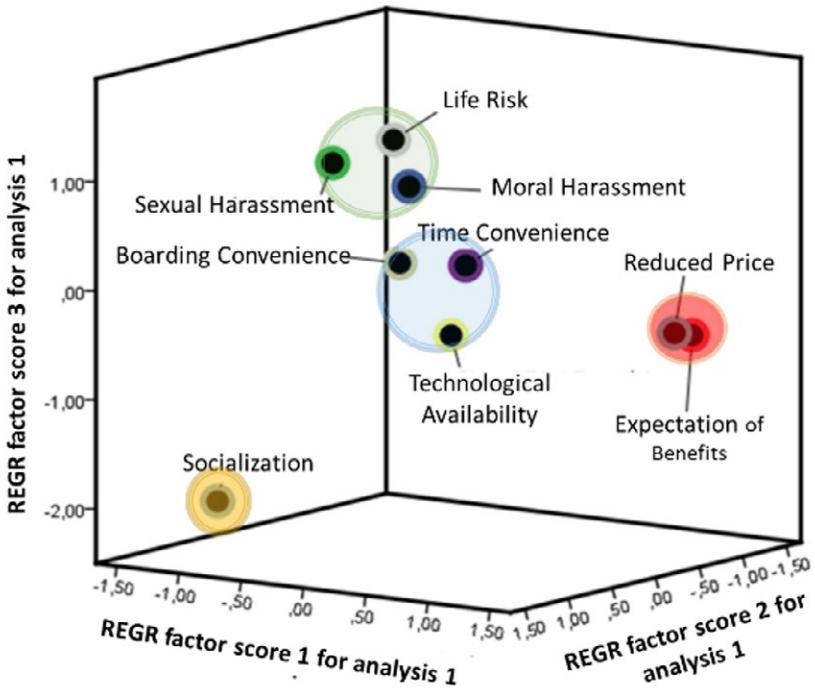


The variables expressed in the model are aligned with the search for an explanation of women's consumption motivators and corroborate with elements evidenced in studies such as those by Martinez *et al.*, 2018; Geissinger *et al.*, 2020; Violin, 2021b.

During the interviews, not only the most relevant variables were determined, but also the (1) reason for use (Work, Leisure, Social Obligations and/or Distinct Responsibilities); (2) and times of use; and the (3) use motivators in each situation.

Thus, from the data set presented in the factor analyses, the Principal Component Analysis was designed, which generated **figure 3**:

Figure 3. - Factor allocation of variables inducing female consumption



Note: Confirmatory Factor Analysis data adjusted in the context of Principal Component Analysis

The dimensionality of the variables presents the decision-making possibilities. In the blue circle, the variables of a technological nature are observed, indicating that they belong to the 3 dimensions. The impact and importance of the technological characteristics of the offer and its ordering form are corroborated by Rangel *et al.*, 2021; Shi *et al.*, 2021.

In turn, the reduced price and the expectation of benefits (red circle) indicate the utilitarian and individual character of the use, that is, the personal advantages associated with the cost are important drivers of use, which is corroborated by Moody *et al.*, 2021; Violin, 2021a.

Such elements distinguish this offer of public transportation modes, which has in its characterization price, time, boarding place and other passengers as variables that cannot be defined by consumers. This inference is echoed in studies such as those developed by the Fia Foundation; CAF, 2017 and Costa *et al.*, 2021 and appear as relevant among the four use motivators listed above.

However, when comparing the dimension in which the variables linked to the perception of security and self-preservation (green circle) are presented, the price is surpassed in the night and dawn period, in other words, as a way of self-preservation, women are willing to pay more for safety during travel, this point is corroborated by Shaheen *et al.*, 2019; Aguilera-Garcia *et al.*, 2022.

Variables of an economic and technological nature added to concerns about risky forms of life and harassment of any nature are part of the decision-making process for the use of ride-hailing by women and is in line with the studies of IFC (2018); Geissinger *et al.*, 2020, particularly due to the volatility of the variables, or in other words, the set of variables changes according to the reason for use and the time of day.

It appears that the time of use and the time of day associated with consumption strongly influence the decision-making process, particularly in relation to the balance between cost, technological ease and the ability of women to protect themselves. This inference is supported by studies such as those by Lagos *et al.*, 2019; Geissinger *et al.*, 2020.

In this way, it is inferred that female consumption behavior can undergo severe changes according to the motivators and the period of use, which means that categorizing consumers into usage ranges may not be an exact measure of the way they make the decision to use. Such notes are corroborated by research such as those by Nourani *et al.*, 2020 and Violin, 2021a.

5. Conclusions

Female consumption behavior starts to appear in the context of the ride-hailing offer as a topic of global importance, considering the impacts of this target audience on the dynamics of cities and the way in which transportation modes are used, whether public or private.

Male and female decision-making have variables in common such as reduced price, technological availability and time and place of boarding facilitators, however, the aspect associated with both physical and psychological preservation forms, in addition to the perception of danger associated with driving in drunkenness or tiredness emerge as distinctive elements in this research.

For the women participating in this study, the use motivators and the time of day when they use the ride-hailing service change the degree of importance of the variables, which leads to the understanding that consumption predictors are not static.

It is observed the absence of variables of a social or environmental nature, which were neglected due to the use being based on utilitarian issues, such as reduced cost and the search for benefits of an individual nature such as facilitating the boarding location and availability during the day supported by a virtual access platform.

The study contributes to the field of knowledge by allowing the understanding that the forms of harassment and the risk to integrity are latent concerns, however, accentuated in certain situations, such as the use at night and at dawn in situations of leisure or social obligations, however, at work or from responsibilities such as visits to doctors, banks, schools, and the whole range of obligations, these elements do not take shape, especially when activities take place in the morning and in the afternoon.

Such an observation does not mean that there is no concern, but that such variables share space with other items of influence, notably those of a utilitarian nature, such as cost and consumption facilitators on offer.

The context exposed up to this point indicates that the interchangeable nature of the valuation of influence variables can bring together inducers of an individualistic nature supported by the technological aspect of the offer subsidized by reduced or even higher cost in certain situations, however, with the perception of being advantageous by virtue of physical and psychological self-preservation.

In this way, the study brings advances to the field of theory by exponentiating the changing nature of the composition of influence elements in relation to their consumption behavior, switching variables according to their moments of use and the associated time of day, in other words, the female consumption behavior is not static, and can combine a set of influencing factors in their decision-making process of use.

The notes of this research could be expanded to include official indicators of forms of violence (sexual, verbal and/or physical) attributed to women during moments of displacement throughout the historical period, in order to understand the extent of the impact of the provision of the ride-hailing, in addition to the investigation of public policies or private actions for the prevention and protection of women, bringing indicators of measured results.

In this way, the study appears as innovative in establishing a benchmark, notably in the field of female consumption behavior, indicating its changeable nature, altering the perception that the variables that influence use are perennial and that the decision-making process is impacted by the reasons for use and the period of the day.

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