Rio PREFEITURA | FUNDAÇÃO JOÃO GOULART

NudgeRio

NUDGE TUNNEL

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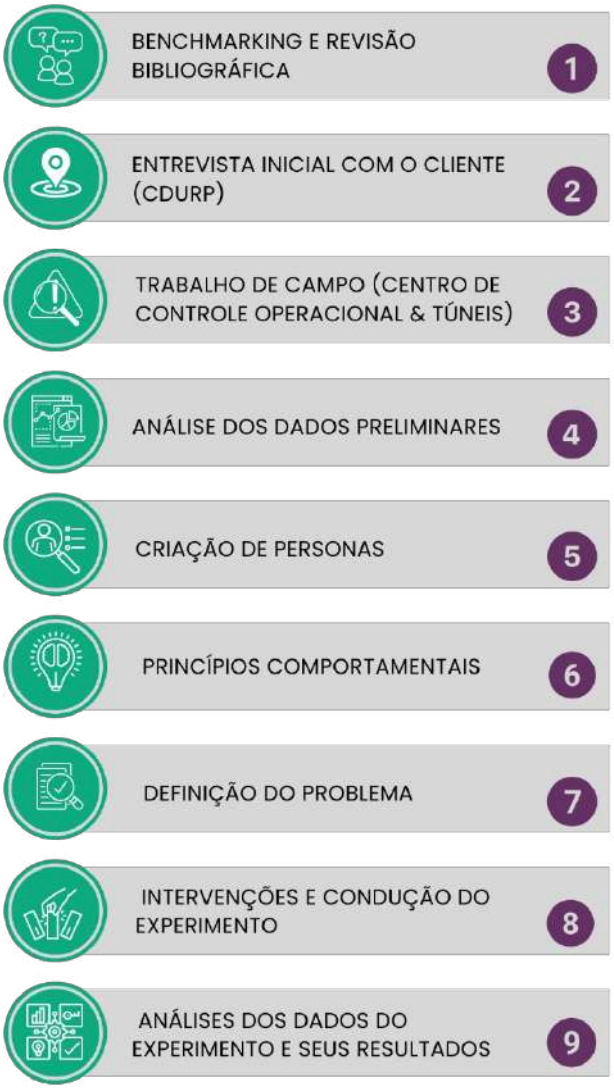
1. INTRODUCTION

The misuse of pull-offs by some drivers in the Marcello Alencar and Rio 450 Years tunnels is a recurring behavioral problem, according to the Companhia de Desenvolvimento Urbano da Região do Porto - CDURP. With this in mind, the João Goulart Foundation Institute was approached to develop a nudge-based solution, based on the implementation of a randomized controlled experiment.

As this is a behavioral problem, NudgeRio was at the forefront of this interaction, since the Nudge methodology is, by definition, an effective tool for suggesting changes in choices that promote derogatory behaviors or that result in harm to individuals, through a new approach to the architecture of choices. In this methodology, the behavior to be stimulated is studied and changes are implemented in the environment so that a new behavioral paradigm emerges.

This project inaugurated a partnership between NudgeRio and the Department of Economics at PUC-Rio, and served as the basis for Final Paper of a student on the BA in Economics. It also had a volunteer external consultant as part of NudgeRio's Guest Behavioral Scientist Program.

The Nudge Tunnel project followed the following steps:



2. PRE-PROJECT

2.1. Benchmarking and Literature Review

After identifying the problem of the improper use of the pull-offs in the Marcello Alencar and Rio 450 Years tunnels, which has been causing a waste of operational resources, and the hypothesis about the motivation of the behavior, the NudgeRio team met with the behavioral scientist guest Tainá Pacheco and with the representatives from PUC-Rio, Sheila Najberg and Anna Pacheco, to draw up a plan for researching the relevant

literature.

With the results of the bibliographical research, we briefly analyzed the evolution of decrees and standards that have been created over time to increase driver safety. With regard to the pull-off, the current standard, both international and national, recommends creating a specific place for drivers to stop in the event of an emergency when they are driving on expressways that are more than 1.5km long. The creation of pull-offs in tunnels is therefore a recent safety standard, which explains why we don't have pull-offs in older tunnels located in the city of Rio de Janeiro.

Figure 1: Emergency pull-off on a highway in the United Kingdom

Source: BBC News

Figure 2: Blanka Tunnel Complex pull-off in the city of Prague.

Source: Blesk.Cz

Based on international examples, it was possible to identify that several pull-offs used different colors from those used in the tunnel environment for signage, generally simple lighting and signs with succinct messages, avoiding overloading the driver with too much information. Only the words "SOS" (Emergency) were displayed more prominently. However, due to budgetary, logistical and legal constraints, which were mapped out in the operational context of this project, it was not feasible to implement changes in the project, such as painting the signs differently from what we usually do and including additional lighting in the two tunnels.

2.2. Initial interview with the client (CDURP)

The pre-project stage is guided by an initial conversation between the members of NudgeRio and the CDURP team in a meeting to align expectations about the executive project. In this first moment, the NudgeRio team presented the fundamental concepts of the Nudge Methodology, so that the clients would be comfortable with the process to be developed and also to make transparent all the experimental work to be carried out. The CDURP team, in turn, presented the following problem: the improper use of the pull-offs (or refuge bays) in the Marcello Alencar and Rio 450 Years tunnels, which has been causing a waste of operational resources. Once it had been identified that this was a problem of behavioral origin, preceded by a decision-making process, it was decided to involve NudgeRio to answer the big question: How can we prevent the improper use of the pull-offs in the Marcello Alencar and Rio 450 Years tunnels, avoiding the waste of operational resources?

3. CONTEXT

3.1. Field Work (Center for Operational & Tunnels Control)

The NudgeRio team carried out fieldwork and made a first on-site visit, both to the Operational Control Center (CCO) and to the tunnels themselves.

Figura 3: Leonardo, responsável técnico da CDURP, apresenta o túnel para Rafaela Bastos, da NudgeRio.

Figura 4: Equipe da NudgeRio examina as barreiras ambientais e informacionais do recuo, na companhia de Leonardo.

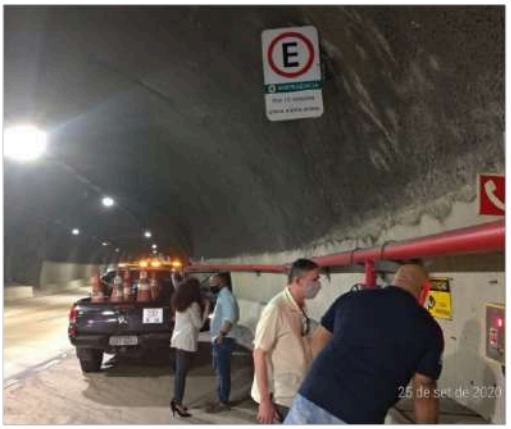


Figura 5: Vista do túnel a partir do recuo.

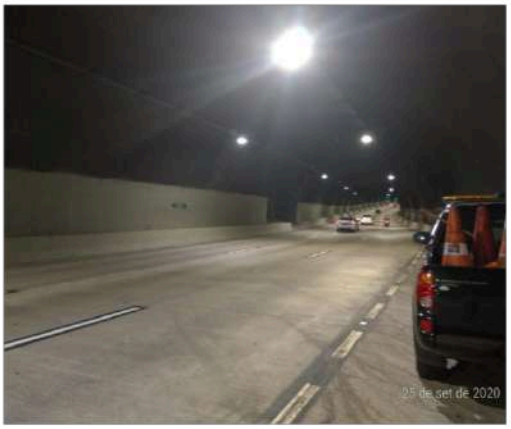
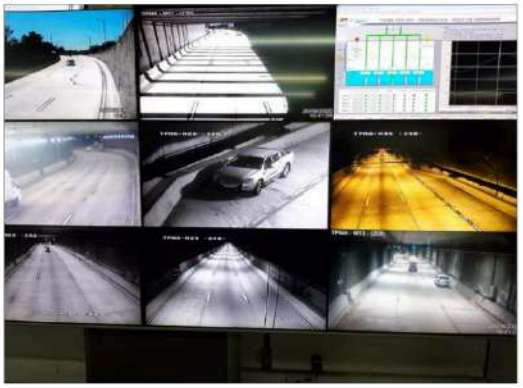


Figura 6: Informações: detalhe da placa, no recuo.

Figura 7: Sinalizações: placa no mesmo recuo.

Figura 8: Telas de monitoramento no Centro de Controle e Operações dos túneis.



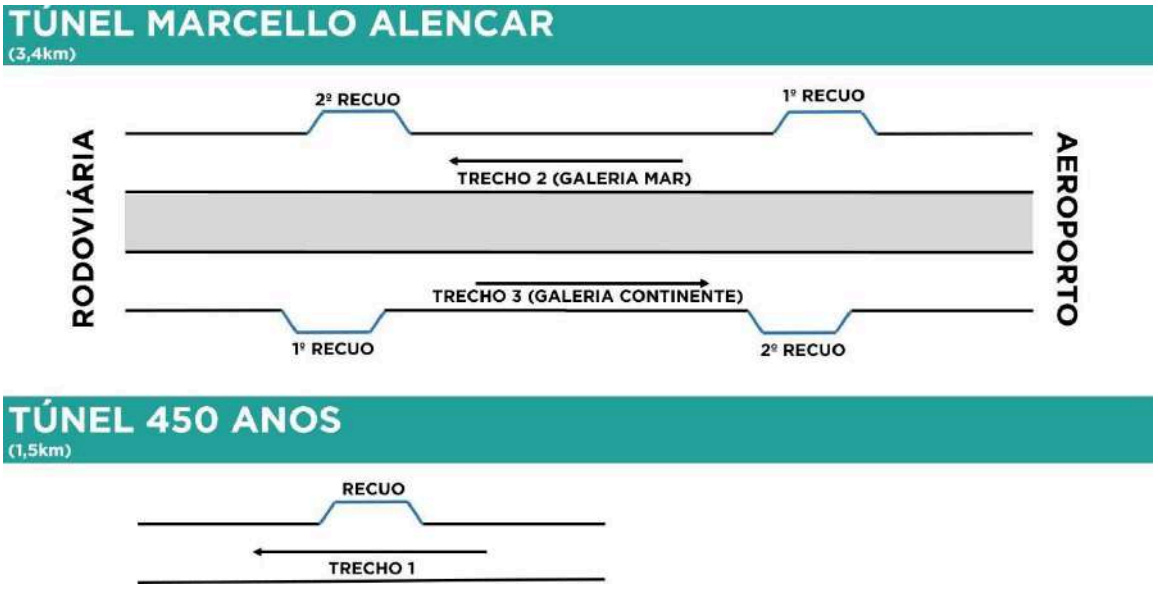
Source: Photos taken by the NudgeRio team.

The fieldwork began at the Operational Control Center (CCO), where the behavioral aspects of the possible experimental subjects were observed with the operators. In other words, the dynamics of how drivers use the pull-offs and the aspects that could have an impact on their decision-making process, such as objects, information, signs, exit and entry into the pull-off and physical space, namely: cameras, signs with explanatory content, vertical and horizontal signs, speed of entry into the pull-off, the driver's field of vision when entering and exiting the pull-off and the temperature and size of the parking space in the pull-off.

An important piece of information we sought was the data or indicators available about the problem pointed out by the public managers and which could be used during the experimental analysis. The CCO representative presented the NudgeRio team with the incident control spreadsheet and provided information on the daily routine of the operation. An interesting fact is that, in just 40 minutes that the NudgeRio team was on site, it was possible to catch the misuse of a pull-off, with a driver stopping to urinate in the lane. Figures 3 to 8 show some of the moments of this visit.

The NudgeRio team was taken by the official operational patrol car to the pull-offs of both tunnels to inspect the sites and familiarize themselves with the existing architecture, for example, vertical and horizontal signage, intercoms, lighting, the size of the pull-off and the presence of monitoring cameras. The team was also provided with a diagram of the tunnels, reproduced in simplified form in figure 9.

Figure 9: Simplified tunnel diagram



Source: NudgeRio/CDURP team

This type of visit is important for condensing information that would otherwise be diffuse and abstract. After the visits, analysis and prior identification of operational resources, it was decided that the intervention would be carried out in the Marcelo Alencar tunnel, as will be described and presented in the following information.

3.2 Analysis of preliminary data

The Marcello Alencar tunnel, inaugurated on June 19, 2016, was built 42 meters below sea level. At 3,370 meters long, it is considered the longest urban road tunnel in Brazil, connecting Av. Brasil, the Rio-Niterói Bridge and Aterro do Flamengo.

This construction was based on international safety standards. It has two galleries, with 9 emergency doors, about 300 meters apart. The operation of each gallery has 8 sets of beacons, which indicate the traffic

condition of each lane, 186 loudspeakers for megaphoning, 46 emergency telephones (call boxes), 6 Variable Message Signs (PMVs) and 22 jet fans divided into 11 100% reversible pairs.

Source: NudgeRio

The two galleries that make up the tunnel are: Continente (towards Aterro do Flamengo) and Mar (towards Av. Brasil). Each gallery has two pull-offs. In the Continente gallery, there are four megaphones and a camera at the end of each one. In the Mar gallery, there are four megaphones (each) and two cameras, one of which is a mobile camera located at the end of the first pull-off, while the other is fixed and in the middle of it. In the second pull-off, one of them is fixed at the end of the pull-off and facing the counterflow; the other is movable and located at the beginning of the pull-off.

The tunnel is monitored 24 hours a day, in partnership with the Rio Operations Center (COR), through 105 cameras, 51 of which are used in the Continente gallery. The images are monitored by the Porto Novo

Concessionaire's Operational Control Center (CCO). The CCO team is made up of an operator, an on-call supervisor, four motorcycle operators, two pickup truck operators, who have a heavy-duty multi- platform winch and a radio system with an exclusive frequency.

In addition, monoxide and carbon dioxide gas sensors (CO and CO^2, respectively), heat detection and opacimeters are also part of the equipment on the road, which also has 1,430 luminaires monitored via remote management. The speed varies and can be 40 Km/h (on the curve), 60km/h (post-curve) and 80km/h (straight line). Access is prohibited for trucks, cyclists, skaters and pedestrians.

The data on incidents attended by the CCO team was provided by the CDURP team in Excel spreadsheet format, in blocks of time (approximately every ten days). The NudgeRio team examined the content of the spreadsheets and realized that they contained data on all the actions of the local team, including regular patrols, unauthorized access by trucks, various incidents and, of course, misuse of the pull-offs.

The original spreadsheet has 19 columns, described below:

Table 1: Description of the fields in the spreadsheets provided by the CCO.

1	**NumOcorrencia**	Um numeral ordinal; um mero organizador do número de ocorrências; a cada novo dia o sistema é "zerado" e a contagem começa novamente do "1".
2	**DataOcorrencia**	A data da ocorrência, no formato DD/MM/AAAA.
3	**TipoOcorrencia**	Um código próprio, de acordo com o manual de operações do CCO.
4	**SubTipoOcorrencia**	Uma coluna raramente preenchida, que visa dar mais detalhes, em caso de necessidade, sobre a coluna anterior.
5	**DescrOcorrencia**	Uma brevíssima descrição sobre a ocorrência em si. Algo do tipo "ronda" ou "pane" ou "congestionamento".
6	**Origem**	Outra brevíssima descrição, sobre como foi descoberta a ocorrência.
7	**HoraOcorrencia**	Registra a hora (hh:mm:ss) da ocorrência.
8	**HoraLibPista**	Registra a hora que a pista foi liberada, nos casos onde houve interrupção do fluxo.
9	**HoraPericia**	Registra a hora da chegada da perícia, nos casos em que esta se fez necessária.
10	**HoraDefCivil**	Registra a hora da chegada da Defesa Civil, nos casos em que esta se fez necessária.

11	**Via**	Identifica a via da ocorrência.
12	**Trecho**	Identifica o trecho da via (coluna anterior).
13	**Sentido**	Identifica o sentido do trecho (coluna anterior).
14	**Local**	Identifica onde aconteceu a ocorrência.
15	**Obs**	Campo livre para o operador adicionar informações que julgar necessárias.
16	**Envolvidos**	Se os envolvidos na ocorrência forem identificados, serão listados aqui.
17	**Recursos Acionados**	Resumo dos recursos que foram acionados por parte do CCO.
18	**Providências**	Resumo das providências tomadas.
19	**Danos Patrimônio**	Breve relatório sobre danos ao patrimônio, quando houver.

Source: NudgeRio/CCO team

In the same spreadsheet, each row corresponds to a single occurrence and the number of rows varies according to the period covered by the spreadsheet.

Thanks to column 3 (TipoOcorrencia), we filtered out and isolated only the unplanned occurrences (truck access, code O10; improper use of the pull-off, O15; and breakdown, P01). The others (patrols, periodic checks, maintenance, etc.) were discarded.

After that, columns 4 to 6, 8 to 10 and 15 to 19 were discarded; columns 11 to 14 were condensed into a single piece of information; column 2 allowed us to create two other pieces of data, one referring to the week of the occurrence (1st week of the month, between the 1st and 7th; 2nd week, between the 8th and 14th; 3rd week, between the 15th and 21st; 4th week, from the 22nd onwards) and another referring to the day of the week (from Monday to Sunday); and finally, column 7 allowed us to create another piece of data, the period of the occurrence ("dawn", between 0:00 and 5:59 a.m.; "morning", between 6:00 and 11:59 a.m.; "afternoon", between 12:00 and 5:59 p.m.; and "night", between 6:00 and 11:59 p.m.).

The new spreadsheet then had nine columns, as shown in Table 2:

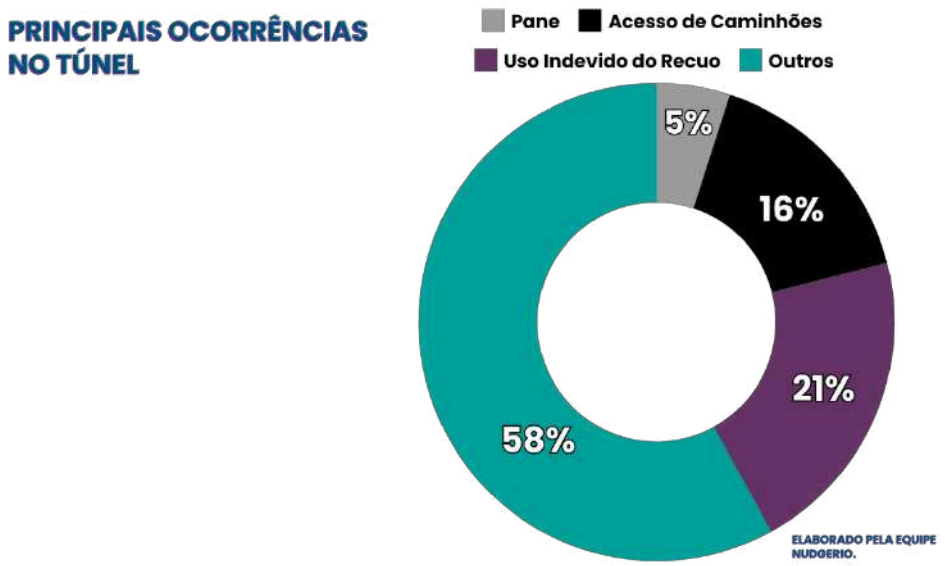
Table 2: Description of the fields in the spreadsheets reformulated by NudgeRio

NumOcorrencia	Um numeral ordinal; um mero organizador do número de ocorrências; a cada novo dia o sistema é "zerado" e a contagem começa novamente do "1".
DataOcorrencia	A data da ocorrência, no formato DD/MM/AAAA.
Semana	Identifica em qual semana do mês aconteceu a ocorrência.
DiaSemana	Identifica em qual dia da semana aconteceu a ocorrência.
TipoOcorrencia	Um código próprio, de acordo com o manual de operações do CCO.
HoraOcorrencia	Registra a hora (hh:mm:ss) da ocorrência.
Período	Madrugada (1), manhã (2), tarde(3) ou noite (4).
Galeria	Identifica uma das duas galerias (Mar e Continente)
Recuo	Identifica o recuo, dentro da galeria especificada anteriormente.

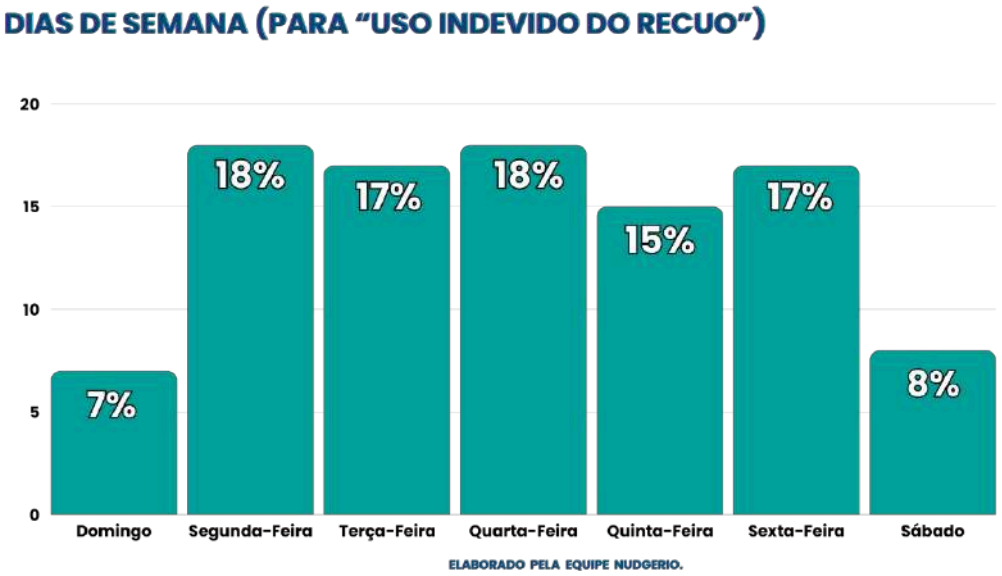
Source: NudgeRio team

Graph 1 shows that of all the incidents recorded, 21% are due to improper use of the pull-off (code O15); Graph 2 shows that improper use of the pull-off occurs evenly throughout the week, and less frequently on the weekends. With regard to time of day, graph 3 shows that morning and evening are the periods of the day with the highest number of incidents of misuse of the pull-offs; the lowest number of incidents occurs in the early hours of the morning. Occurrences of improper use of the pull-off are mainly in the Marcello Alencar Tunnel, and are more frequent in the Mar gallery, as shown in Graph 4. Graph 5 shows the distribution of improper use of pull-offs specifically in the Mar gallery.

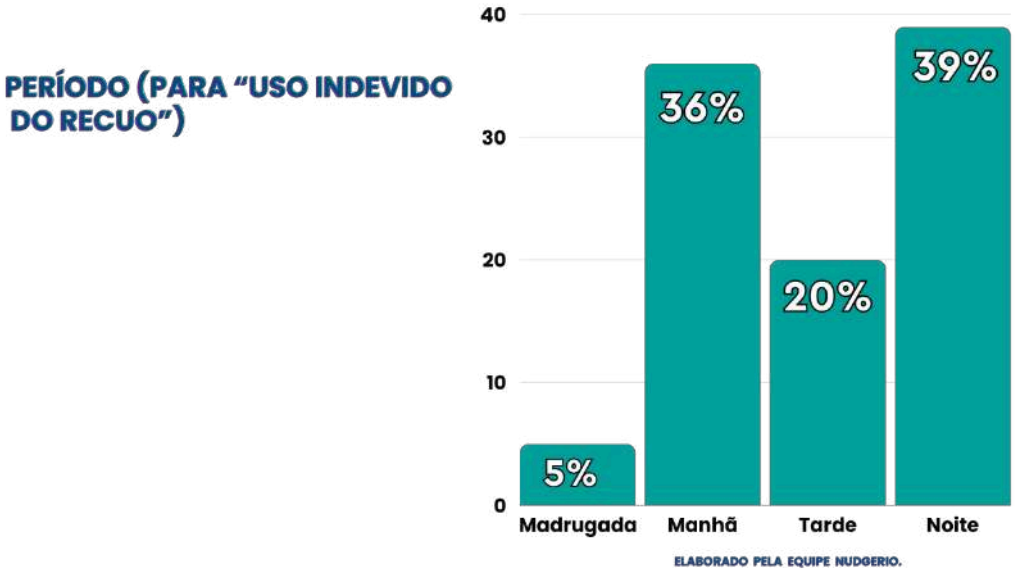
Graph 1: Distribution of the main incidents evaluated.



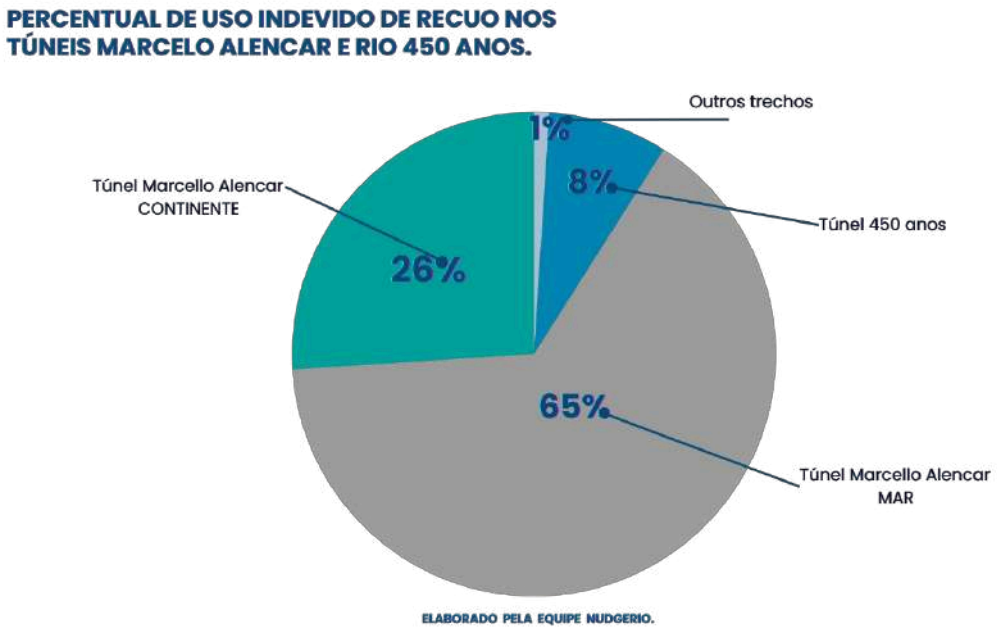
Graph 2: Distribution of undue use of the Marcello Alencar Tunnel pull-off throughout the week



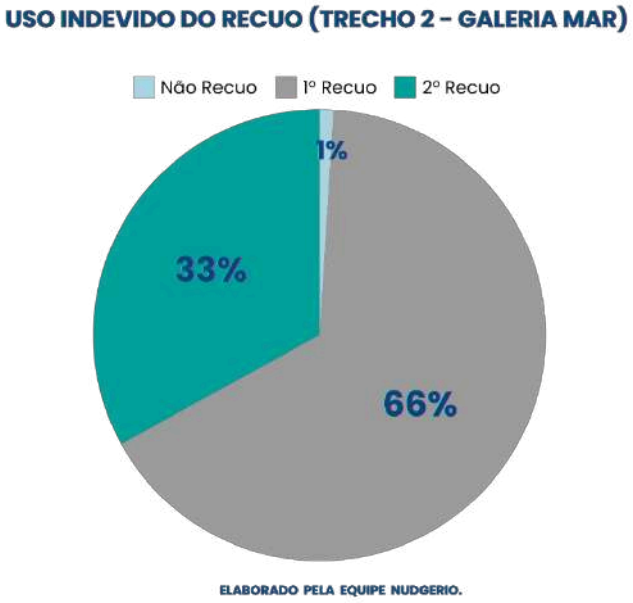
Graph 3: Distribution of undue use of the Marcello Alencar Tunnel pull-off throughout the day.



Graph 4: Distribution by gallery of improper use of the pull-off (The "Other sections" slice refers to incorrect data).



Graph 5: Distribution of improper use of pull-offs in the Mar gallery (The "not pull-off" slice refers to incorrect data).



4. CONTEXT ANALYSIS

Once the problem had been defined, part of the analysis of the context included the application of a questionnaire to validate some of the issues considered by the team of researchers and consultants invited.

The team decided to create a form on Google Forms with nine questions, which measured awareness of what a pull-off is, the type of driver and the notion of an emergency situation.

The first three questions asked whether the citizen/driver recognized the definition of a pull-off:

1. Do you know what a tunnel pull-off is?
2. Have you ever seen an pull-off in a tunnel?
3. Have you ever stopped at a pull-off in a tunnel?

The next questions, 4 and 5, asked about the motivation for using a pull-off.

4. Which of the reasons listed below would be a reason for you to stop in a tunnel pull-off? Check all that apply.
5. In your opinion, is it problematic to use a pull-off inside the tunnel if it's not an emergency?

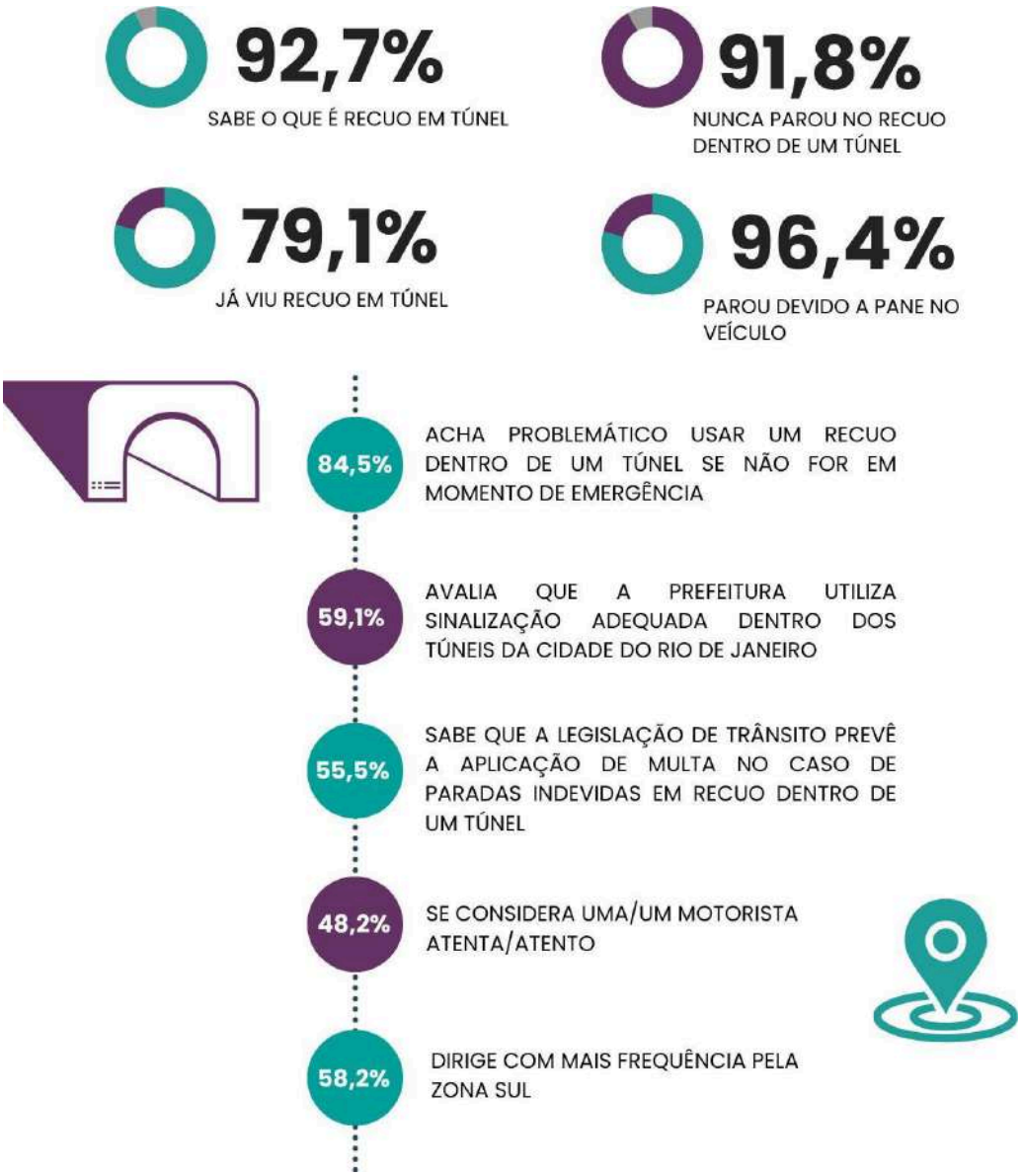
Questions 6 and 7 were designed to assess whether the citizen/driver recognizes the pull-off inside a tunnel as part of their understanding of traffic, as well as whether its signage is adequate.

6. Do you think that the City Hall uses adequate signage inside Rio de Janeiro's tunnels?
7. Did you know that traffic legislation provides for a fine in the event of undue stops in a tunnel pull-off?

Questions 8 and 9 asked for a self-declared typification of how citizens see themselves as drivers and how they get around the city.

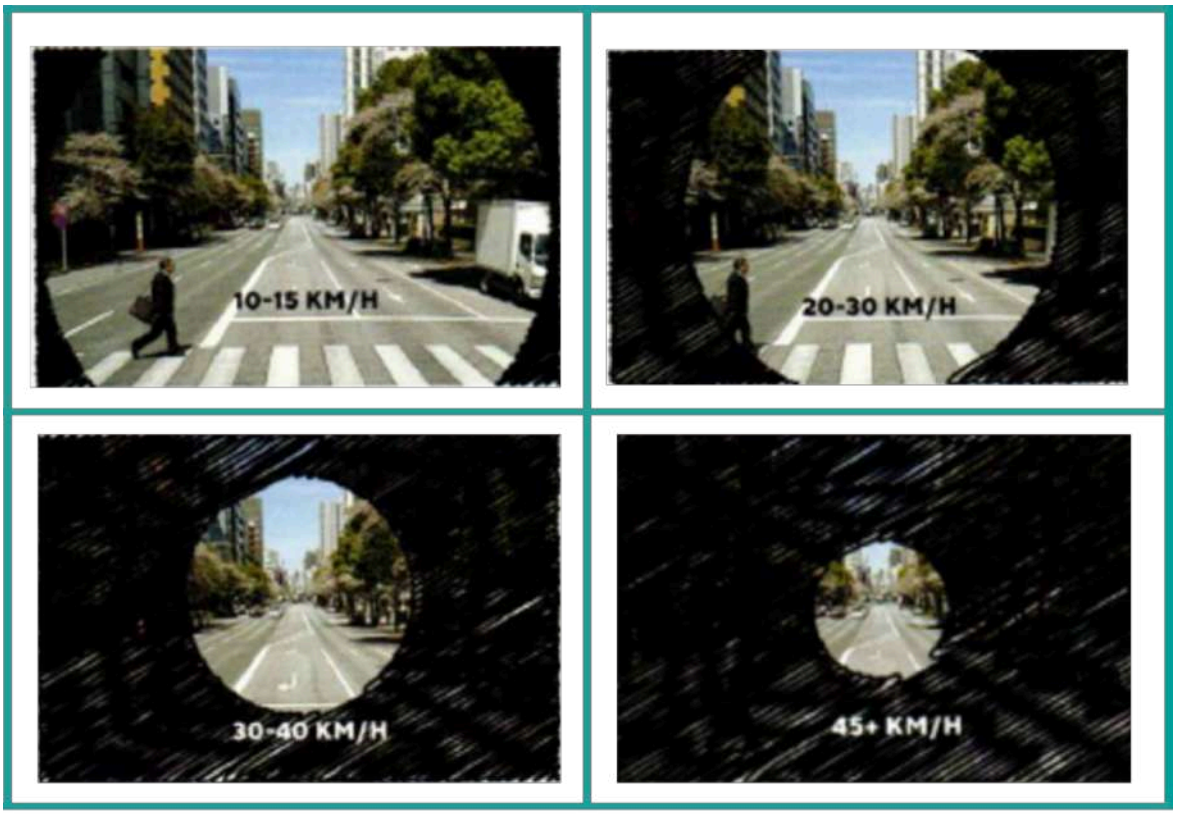
8. Which of these terms best describes the type of driver you consider yourself to be:
    - Cautious
    - Attentive
    - Skilled
    - Impulsive
    - Audacious
9. You are a driver who often drives more in which area(s):

The team participating in the project, with the exception of Thaina, sent links to the form via WhatsApp to be filled in at random. The form was available to fill in for 10 days. A total of 187 respondents took part in the survey, which showed the following results:



Studies have also looked beyond the questionnaire to understand the behavior of drivers and, in this regard, the field of attention by traffic speed stands out. The faster a person travels, the smaller their field of vision and attention to the objects around them, as shown in figure 10:

Figure 10: Field of attention of drivers according to speed



Source: "Copenhagenize: The Definitive Guide to Global Bicycle Urbanism, by Mikael Colville-Andersen"

Since the tunnel is an expressway, the communication installed inside the pull-off will be seen very briefly, and therefore needs to communicate the correct message as simply as possible. The situation found in the pull-offs of the tunnels visited was the opposite of what was desired: because of the driver's reduced field of attention, the sign in the pull-off gives the impression that parking is allowed there, as shown in figure 11.

Figure 11: Signpost in the pull-off, seen from a distance, giving the impression that parking is allowed

Source: NudgeRio team

Returning to the field of attention in relation to speed, it makes sense to assume that the sign induces a stop. The information that the stop can only take place in an emergency, for only 15 minutes and with the warning light on is only known once the stop has been made and the driver is closer to the sign. When the driver realizes that the stop is improper, the tunnel's operational team will have been activated.

5. APPROACH DESIGN

5.1. Creating Personas

NudgeRio has used personas in many of its experiments. The creation of personas is based on applied qualitative or quantitative questionnaires, in phases prior to the design of the approach and, subsequently, the benchmarkings carried out. In the stage that follows, after the benchmarkings, there are good indications of what may or may not work and this can be a biased opinion. If we don't pay attention to the reality presented to the experimental subject, who will be exposed to the stimuli of the experiment's choice architecture, we can easily make mistakes based exclusively on experiences from other cultural contexts and the individual repertoires of the project participants.

In this regard, NudgeRio has opted for two specific methodological practicesThe application of the persona methodology is aimed at reducing the biases of researchers dealing with the experimental approach, so that behavioral scientists can better identify their own biases when developing solutions for choice architecture. The proposal here is that each researcher can move away from their repertoire in the production of critical thinking and come to produce questions and propositions centered on the experimental subject and less on their individual trajectories and experiences.

The other methodological practice is based on data and, in this case, is a more objective relationship with the idea of a profile for the experimental subjects. Here, using other Design Thinking tools, it is possible to create possibilities, reflections and hypotheses of what might work as an experimental approach. From a set of demographic, psychographic and behavioral data, profiles are created that can realistically exist and thus be able to predict some possible behaviors, a predictability that always associates the possibilities with existing bibliographies. This creates an architecture of choices that has ample capacity to reduce decisions that are not beneficial to individuals and increases the success rate the experiment that will be carried out.

In the current study, for the Nudge Tunnel Project, the methodological use of personas met the first objective, to reduce the researchers' biases when it came to questioning, hypothesizing and reflecting on the experimental subject. However, the questionnaire also broadened the researchers' understanding of exploratory questions, such as: Does the driver know what a pull-off is? Does the driver know what an emergency situation is, according to the traffic code? The set of data and reflections allowed us to first make a practice of understanding the profiles through a division: a) based on knowledge of what a pull-off was and b) considering the premise of a correct notion of what constitutes an emergency situation.

Characteristics such as driving location and driver profile were not used in the construction of the personas, since they were relatively constant among all the different respondents. , we didn't use information about whether the person knew about or had seen a pull-off, as this also a uniform response pattern among those who knew what a pull-off was. In , the percentage of people who had stopped in an pull-off was too low (7%) to be used to build a profile.

The total of 187 respondents provided a set of answers, described in section 4.5 of this report. Considering the results of the questionnaire and the insights that emerged, the personas were qualified with the following characteristics:

- **Aware -** Drivers who know what a pull-off is, have seen it or are aware of it and are aware that it is bad behavior to stop in pull-offs, outside of emergency situations, and correctly classify what makes up an emergency situation (around 60%). They consider the signage in tunnels to be inadequate (around 40%) and are unaware of the legislation on fines for improper stopping.
- **Mistaken -** A driver who knows what a pull-off is, has seen it and believes that it is problematic to stop if it is not an emergency, but is unable to correctly identify what is an emergency moment (considers situations such as fiddling with a cell phone or waiting for 15 minutes to be justifiable). They consider the signage in tunnels to be inadequate and are unaware of the legislation on fines for improper stops (around 27%).
- **Inattentive -** Drivers who don't know what a pull-off is, consider the signage in tunnels to be inadequate and are unaware of the

legislation on fines for improper stops (around 10%).

Based on the premise and objective of reducing the researchers' biases, the next steps were to study and map the behavioral principles based on these personas, as we will see in the next section of this report, creating a qualitative method for the researchers' analytical process. Information is tabulated, guided by the experimental subjects chosen for the design of the approach, based on a qualitative questionnaire, about existing actions promoted by the City Council, a description of the objects and aspects that currently exist, which can be incentives for current behavior or expected conduct. The questions that can motivate the decision of each individual, defined as an experimental subject, in their decision-making process that results in stopping the pull-off. Also qualified and reflected are the environmental, informational, emotional and behavioral barriers that are part of the decision context of the profiles that guide the reflections on the experimental subjects methodologically. And finally, the biases and heuristics that may be at work or activated in the decision-making process.

5.2. Behavioral principles

NudgeRio constantly seeks to develop experiments as an executive project so that it can document the processes and help create and define criteria for choosing one experiment over another, based on what we call the operational context. This is nothing more than an analysis of the capacity of the parties involved in carrying out the experiment and also the technical assessment for receiving the data that will be extracted as the intervention is carried out. This section reflects on the specific conceptual

model, in which categories and relationships were created to understand the gap between an individual's action and intention.

For behavioral scientists, it is of the utmost importance to have tools to create practices and methods for classifying nudges, which include, for example, emotional, cognitive and social biases and the dual model of thinking, System 1 or System 2. Another relevant aspect is that this conclusion also takes into account the project's execution capacity and restrictions, measurement and experimentation, if the use of information is clear, the decision structure and what can help the experimental subject's decision to change their behavior for the benefit of themselves and society.

The definition of the experimental subjects, associated with the limitations of the experiments, pointed to the possible and eligible treatments for this public in the context studied, as well as highlighting the relevance of an approach that combines a strategy of emotional stimuli, based on these experimental subjects and, thus, activates an expectation of punishment or emotion that implies a removal of the unwanted conduct and increases the chances of success of the experiment.

Emotion is considered an expectation factor for making choices. In this study, emotional stimuli were indicated as effective in resulting in operational behavior, i.e. not stopping in pull-off. This type of behavior was encouraged through decision architecture, with individuals being stimulated by a sense of urgency.

The intervention prioritized the combined strategy of environmental stimuli, with an emphasis on signage and communication in the tunnel and in the pull-off itself, for the experimental subjects. At this stage of the

project, it was defined that the experiment would consist of displaying messages on Variable Message Signs (VMS) as well as vertical signage within the pull-offs. Possible framings and emphases were then identified, along with behavioral effects that could be effective in the context of the intervention, biases, and the expected conduct resulting from the treatment. The approach was designed using a method that qualifies the barriers that prevent a beneficial decision-making process for the citizen/driver.

O presente experimento, entretanto, não irá medir a diferença entre os períodos distintos de paradas indevidas de motoristas nos recuos que fazem parte do experimento.

The behavioral principles have been categorized as follows to reflect the behavioral effect that would produce the right stimulus to change behavior:

Through these steps it was possible to evaluate the behavioral principles robustly, considering the limitations of experiments of this nature, and to qualify a design for the intervention and a decision architecture for the context.

5.3. Defining the problem

After initial interviews with the client (CDURP), during which discussions and a site visit took place, the NudgeRio and CDURP teams reached agreement on the following issue associated with the behavioral variable: "Inappropriate use of the pull-off by drivers".

The different misuses strictly have the same operational impact:

every time a driver makes use of the pull-off, the on-duty team goes into a state of alert, resulting in a team going to the scene to investigate the incident and provide the necessary support. It should be noted, however, that in order to understand the behavior of individuals, reflections and studies were carried out that considered the different uses and associated aspects in a qualitative and quantitative questionnaire that was mentioned in item 4. of this report.

Improper use of the pull-off impacts the efficiency of the support team and negatively affects the budget planned for this activity. This is because a whole operational apparatus is activated to deal with a non-urgent incident, in accordance with the safety parameters and traffic instructions in the tunnel.

The analysis of the problem led us to a simple and straightforward hypothesis: "the correct use of pull-offs is due to the availability of information and prominence in the physical space". To test it, we need to understand how we can pass on this information to drivers, restricting ourselves to the type of interventions that are possible within the current legislation, the available budget and the proposed timetable.

6. EXPERIMENT

6.1. Interventions and Conducting the Experiment

Based on the data and analysis, a number of interventions were proposed, which are described in the summary of the approach below:

EXPERIMENTO NUDGE
SUJEITO EXPERIMENTAL: MOTORISTAS QUE TRAFEGAM PELOS TÚNEIS MARCELLO ALENCAR E RIO 450 ANOS. **CONDUTA A SER MUDADA:** PARADA INDEVIDA NAS BAIAS. **INTERVENÇÕES SUGERIDAS:** - RETIRAR A PLACA "PARADA PERMITIDA POR 15 MINUTOS"; - COLOCAR PLACA "PROIBIDO ESTACIONAR E PARAR"; - PINTAR O CHÃO DAS BAIAS PARA REFORÇAR A IDEIA DE PARADA DE EMERGÊNCIA; - ILUMINAR MAIS FORTEMENTE O LOCAL, PARA CONSTRANGER AS PESSOAS QUE PARAM; - TORNAR SALIENTE AS CAMPAINHAS E CÂMERAS; - VEICULAR MENSAGENS ATRAVÉS DO PMVs, A PARTIR DAS PERSONAS CRIADAS.

A typical experiment conducted by NudgeRio involves a randomized controlled trial, where the total population is divided into two segments (control group and treatment group) and only one of these segments, the treatment group, undergoes the proposed intervention. This makes it possible to compare the results of both groups, over the same time horizon, and draw robust conclusions about the effectiveness of the intervention.

In the case of the tunnel experiment, this method was not possible, since there was no way of separating the population into two equivalent, randomized groups, so that one of these groups could act as a control group. Therefore, it was decided to conduct the experiment on the entire population over time, comparing the results with data from the previous stages.

Having made this proviso, and once the interventions, messages on the Variable Message Signs (VMPs) and new signs had been decided, the

experiment was divided into three phases, each lasting two weeks.

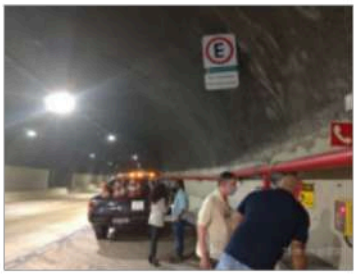
In the first phase, which began on Thursday 27/5/2021, the Variable Message Panels (VMPs) displayed the messages drawn up for the intervention on a daily basis, based on the heuristics and biases described in the previous section. This phase ended on Wednesday 9/6/2021.

EXPERIMENTO

O presente experimento será realizado em 3 etapas:

1) Frase no PMV por duas semanas no túnel Marcello Alencar;
2) Frase no PMV + Placas de sinalização por duas semanas;
3) Apenas placas de sinalização.

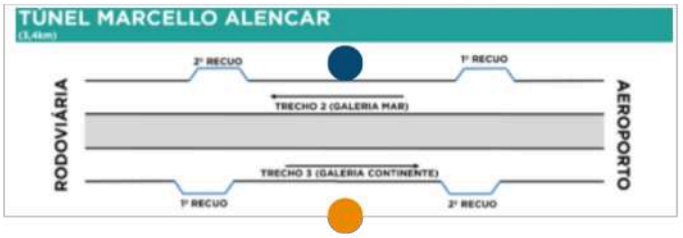
A placa sugerida de Estacione deverá ser retirada do local.



EXPERIMENTO – ETAPA 1

Frases para serem veiculadas no PMV por quatro semanas, a saber: Semana 1, Semana 2, Semana 3 e Semana 4.

SEMANA 1						
DIA 1	DIA 2	DIA 3	DIA 4	DIA 5	DIA 6	DIA 7
SEMANA 2						
DIA 1	DIA 2	DIA 3	DIA 4	DIA 5	DIA 6	DIA 7



GALERIA MAR

PARADA INDEVIDA NO RECUO = RUIM PARA TODOS

GALERIA CONTINENTE

PARADA INDEVIDA NO RECUO = PEDIDO DE SOCORRO

PARADA INDEVIDA NO RECUO = REBOQUE

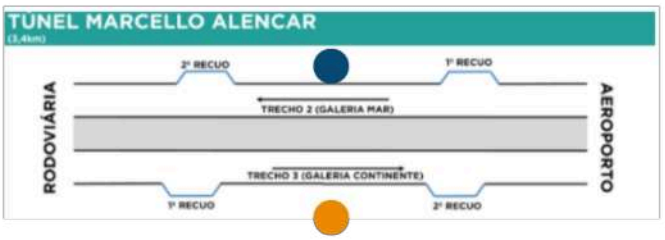
NÃO PARE EM RECUO SEM SER EMERGÊNCIA

EXPERIMENTO – ETAPA 2

Frase no PMV + Placas de sinalização por duas semanas - Semana 3 e 4.

Frases para veiculadas no PMV semanas 3 e 4 + placas em todos os recuos, nos dois sentidos.

SEMANA 3						
DIA 1	DIA 2	DIA 3	DIA 4	DIA 5	DIA 6	DIA 7
SEMANA 4						
DIA 1	DIA 2	DIA 3	DIA 4	DIA 5	DIA 6	DIA 7

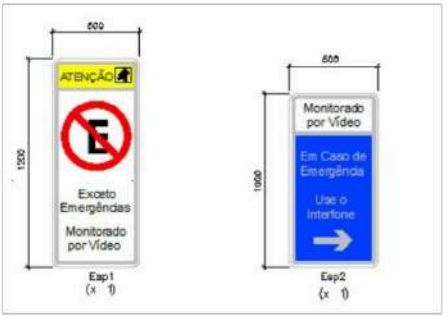


GALERIA MAR — PARADA INDEVIDA NO RECUO = RUIM PARA TODOS

GALERIA CONTINENTE — PARADA INDEVIDA NO RECUO = PEDIDO DE SOCORRO.

PARADA INDEVIDA NO RECUO = REBOQUE

NÃO PARE EM RECUO SEM SER EMERGÊNCIA



EXPERIMENTO

Placas de sinalização - Semana 5 e 6.

As frases selecionadas para serem veiculadas no PMV devem ser retiradas, permanecerão apenas as placas em todos os recuos, nos dois sentidos.

SEMANA 5						
DIA 1	DIA 2	DIA 3	DIA 4	DIA 5	DIA 6	DIA 7
SEMANA 6						
DIA 1	DIA 2	DIA 3	DIA 4	DIA 5	DIA 6	DIA 7

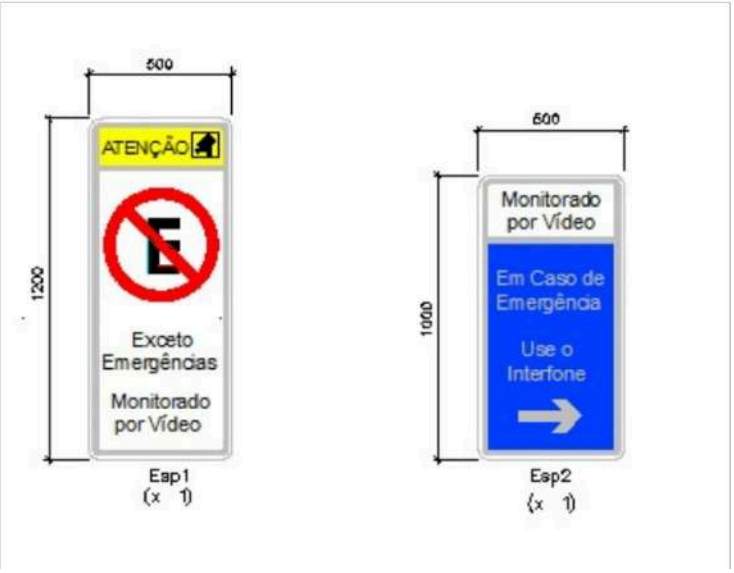


Figure 12: Image of one of the Variable Message Signs (VMPs), taken from a monitor in the CCO, showing a pair of messages

Source: NudgeRio team.

On Thursday, 10/6/2021, we started the second phase. The PMV stimuli remained and the new signs were added to them (figure 12). It is important to highlight the partnership between CET-Rio, which modeled the new signs, and PUC-Rio, which covered the costs of making and installing them. The set of signs and Variable Message Signs (PMVs) remained active until June 23, 2021.

Figure 13: Intervention plaque.

Source: NudgeRio team.

On 24/6/2021, again a Thursday, the third and final phase of the experiment began. The awareness-raising messages were removed from the Variable Message Signs (VMPs) and the signs became the only intervention. This phase officially ended on 7/7/2021 but, for obvious reasons, the new signs remained in place, no longer as an "intervention", now as part of the permanent backdrop to the pull-offs.

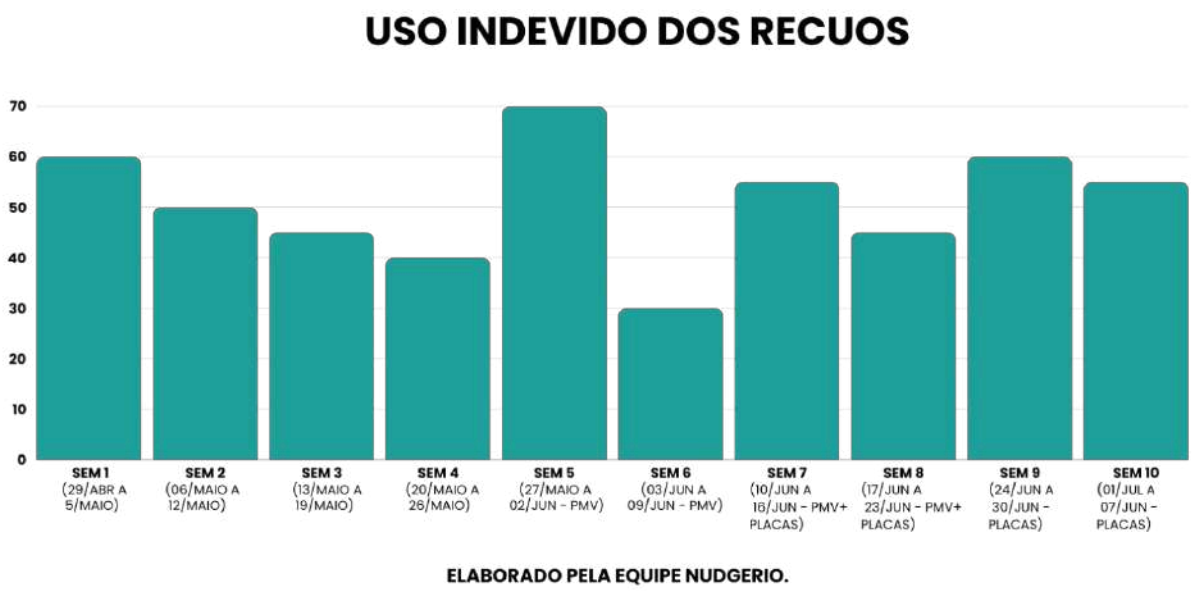
At each two-week interval, corresponding to a phase of the experiment, the CCO team passed on the data from its operations to the NudgeRio team, which analyzed it from the perspective described in section 4.4. The following section deals with this analysis.

7. RESULTS

7.1. Analysis of Experiment Data and Results

The data from the six weeks in which the experiment was conducted was processed and analyzed by the NudgeRio team. Graph 6 shows the total figures for the six weeks of the intervention, as well as for the previous four weeks.

Graph 6: Total amounts of misuse of the Marcello Alencar tunnel's pull-offs per week



Some obvious readings from the graph above:

- There seems to be a natural downward trend in occurrences over the four weeks prior to the intervention;

- The initial week of the experiment showed a spike in occurrences.

This cannot be attributed to the intervention itself (a case of the opposite effect), but it cannot be ruled out either;

- The sharp drop in the second week of the intervention, compared to the first week, may be due to an extended holiday (Corpus Christi) that took place between Thursday and Sunday.
- The fluctuations over the next four weeks do not point to any definitive conclusions regarding the interventions.

Compared to the behavior before the interventions, which apparently showed a steady decline over four weeks, an analysis was made over a longer period time, from September 2020 to July 2021, as shown in Graph 7:

Graph 7: Historical series of the number of undue stops in the pull-offs in the Marcello Alencar tunnel.

Prepared by the NudgeRio team

Graph 7 shows the number of undue stops on the pull-offs from 24/9/2020 onwards. The week from 24/9/2020 to 30/9/2020 is identified as "1" on the abscissa axis and so on. It also shows the four-week moving average curve and two fixed averages (identified in the graph legend as "fixed average 1" and "fixed average 2").

These fixed averages were generated based on the observation of the total quantities; the moving average shows a steady drop from week 24 (4/3/2021 to 10/3/2021) and so we decided to generate a fixed average with the data from weeks 1 to 24 (represented by the red horizontal line) and a fixed average with the remaining weeks (green horizontal line).

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INSTITUTIONAL

MAYOR

Eduardo Paes

PRESIDENT OF THE JOÃO GOULART FOUNDATION INSTITUTE

HEAD NUDGERIO | LABFAZ

Rafaela Bastos

NUDGE TUNNEL PROJECT TEAM

Alexandre Cherman
Rafaela Bastos
Sérgio Bastos

INVITED BEHAVIORAL SCIENTISTS

Anna Pacheco
Tainá Pacheco
Sheila Najberg

AUTHORS OF THIS PUBLICATION

Alexandre Cherman
Rafaela Bastos
Sérgio Bastos

REVIEWERS OF THIS PUBLICATION

Alexandre Cherman
André Appariz
Antônio Matheus de Sá
Jorge Marcelino
Marcela Lima
Maria Clara Muniz
Pedro Arias Martins
Pedro Zaidan

Rafaela Bastos

JOÃO GOULART FOUNDATION INSTITUTE

PRESIDENT

Rafaela Bastos

COMMUNICATION AND BRANDING

Flávia Santos

TRAINING AND DEVELOPMENT COORDINATOR

Rafael Costa

LEADERSHIP MANAGEMENT COORDINATOR

Bárbara do Nascimento

PROJECT DEVELOPMENT AND CROSS-CUTTING COORDINATOR

André Appariz

COORDINATOR OF DATA AND BEHAVIOR | NUDGERIO | LAB.FAZ

Pedro Arias Martins

ADVISORS

Marcela Lima
Jorge Marcelino
Pedro Zaidan

INTERNS

Daniel Levacov
Maria Clara Muniz