**🟪 Slide 1 – Title / Personal Motivation**

Hello everyone thank you all for being here I'm Sara Herranz and today I’ll be presenting my final project“**Modeling perceived urban insecurity: an empirically grounded agent-based simulation**.” which was supervised by Iñaki úcar.

For the past five years I’ve been interested in urbanism, gender and fear, and **how the spaces we move through are not neutral, but they are experienced differently depending on who you are**. Although in previous work I focused on sexual street harassment, I’m still interested in understanding why some people feel safe in public spaces while other others don't.

This thesis was my chance to explore this topic with new tools.

**🟪 Slide 2 – Why perceived insecurity? Why Agent-Based Modeling?**

So, we often rely on crime statistics to talk about safety, but they don't tell the full story: fear is not just about crime, it is shaped by what we see, where we are, and how we move through the city. In sociology, the concept fearscapes refers to places where certain urban settings create avoidance behaviors that lead to an unequal usage of public spaces.

Traditional tools are usually too static because they miss this relational side of insecurity. However, Agent based models, or ABMs, let us simulate interaction **between individuals and their surroundings in space and time**. We can also try out “what if” scenarios and see how perceptions evolve.

**🟪 Slide 3 – Main Aim and Objectives**

So, the main goal of my thesis is to develop a simulation-based methodology that helps to test and explore insecurity in different urban contexts, using real data, for Research and Policy planning purposes.

To achieve this, I structured the work around four areas:

First, rethink insecurity as something relational and stratified. Second, to calibrate the model using survey data and gis layers. Third, to test robustness with replications and sensitivity analysis. And finally, to provide a flexible tool that can be used with any data, like the one my colleague Clara is developing for her master thesis.

**🟪 Slide 4 – Main Aim and Objectives: Pamplona as case study**

I chose Pamplona as a case study because they have recent data, from 2023, which includes different psychosocial variables that, according to the literature, are essential to understand insecurity perception as relational and dynamic.

**🟪 Slide 5 – Data and Model Design**

Here’s a workflow of the model design that shows the different types of data I used.

First, I used different shapefiles that helped me create the basis of the model’s environment. This environment was enhanced with a crime proxy for each barrio. I used the Balance de Criminalidad del cuarto trimester de 2024 del Ministerio del Interior and, since it only had data on the municipal level and I wanted to descend to a neighborhood level, I combined this objective data with subjective data from the survey.

Finally, I used survey data to run a categorical principal component analysis on several items related to perceived urban insecurity. The first two components accounted for around 60% of the variance, and were used as dependent variables in a multivariate linear regression to identify key predictors that were used to define agent characteristics. Only the first component due to its statistical weight and time constraints.

**🟪 Slide 6 – Model display**

Here’s the map display of the model. Each neighborhood has an associated lightning score and a crime score. There are also parks and squares, where botelloneros, these purple circles, are located. These are young people drinking alcohol in public spaces, and appear only at night in certain days of the week and can affect certain residents that are sensitive to them.

This tiny dots are the residents. Each of them has a daily routine: they go from home building, to work building, and they can either return home or go for leisure in a leisure building. They use roads to move around the city.

Prediction is the perceived insecuirity, and is actually the most important part of the model. It’s a linear combination that depends on personal characteristics, if they cross paths with botelloneros, and on night modifiers like crime sensitivity and lightning sensitivity.

So basically, fear emerges from interactions between people and places.

**🟪 Slide 7 – Model display**

In the interface, users can change parameters like the number of residents or botelloneros. This is the output display, where we can see, for example, mean prediction by neighborhood, or how many people is feeling insecure based on a threshold you can adjust in the simulation.

**🟪 Slide 8 – Scenario 1**

I want to give now two brief examples to illustrate the potential of the model.

First, let’s imagine it’s Friday night. Small groups of young people gather in squares and parks. Some people are not bothered by this, but others find this triggering and feel insecure around them. The City Council tell us: hey, should we worry about this?

These are the results of one of the One at a time sensitivity analysis I carried out but it’s perfect for this. It increases the number of botelloneros around the city, and here is the interesting part: the average prediction stays flat, but maximum predifcted fear spike with 9 and 12 groups.

This is important because it shows the effect is not linear, but it’s stratified: despite that “on average” everything looks fine, the model helps us visualize **hidden vulnerabilities** and reinforces this idea that space can feel very different depending on who you are

**🟪 Slide 9 – Scenario 2**

Another example I wanted to introduce is the Sanfermines. Although I did not included it in the written thesis, it is perfect to explain the potential of this model.

During these days Pamplona transforms massively: crowds, alcohol, and temporary urban features reshape movement.

A model like mine could be used to simulate **how these changes affect perceived insecurity and support event planning or preventive urban policy from the city council**. A few technical adjustments would be needed, for example, we could increase the probability of leisure outside, add parameters for crowd density, and temporarily modify the urban layout.

**🟪 Slide 10 – Contributions**

So, this model moves beyond purely criminological approaches, as it understands fear as lived and subjective.

It also builds on previous ABMs on this topic, adding some key improvents**: First, mine has more realistic agents with heterogeneous traits, and also it has a temporal component, distinguishing day and night dynamics**.

Finally, due to its strong linkage to real data, this model is theoretically grounded, empirically plausible and practically useful for researchers, urban planners and policymakers.

**🟪 Slide 11 – Limitations and perspectives**

However, of course there are some limitations. One of the main one’s is that agents follow fixed routines and don’t change their behavior based on their experience. Also, although the model accounts for compounding risks, **interaction effects between variables are not formally tested on a wide range of scenarios**.

There is also circularity in the crime parameter, since it was created using perception and I intend to measure its effect on perception.

To address all of this I propose to add feedback mechanisms, so agents can adapt; test global sensitivity using methos like sobol indices, maybe also include georreferenced crime data, and eventually **including more dynamic urban elements**, **like real time crowd flows**.

Sí, una regresión me permitiría ver si el efecto de los botelloneros es mayor en mujeres, incluyendo una interacción.  
Pero una regresión no me permite ver **quiénes generan los casos extremos**, ni **en qué condiciones concretas surge el miedo máximo**.  
En cambio, con el modelo ABM puedo ver que las predicciones más altas las genera **siempre una mujer**, y que eso ocurre en ciertos escenarios emergentes que combinan género, barrio, y exposición.  
Es un tipo de evidencia diferente: **más contextual, más granular, y más útil para pensar en intervenciones urbanas específicas**