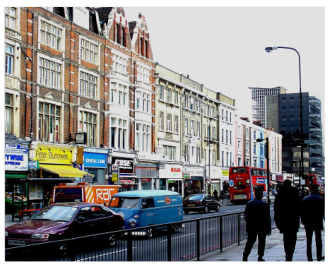
An agent-based model of jaywalking

Representing contested street space in models of pedestrian movement

OBI THOMPSON SARGONI, The Bartlett Centre for Advanced Spatial Analysis, UCL
ED MANLEY, School of Geography, University of Leeds

Motivation

Pedestrians' choice of where and when to cross the road is influenced by many factors including pedestrian attitudes, road infrastructure and traffic levels. These factors vary across space and time and give rise to differences in how street space is used in different urban areas, illustrated by the pictures to the right. Modelling how pedestrians adapt their road crossing behaviour to their local environment can help us consider how a city's limited street space could and should be used in the future. This is important because a good way to prioritise urban sustainability and health is to ensure street environments prioritise walking and cycling.



Edgware Road (top) and Seven Dials (bottom) - two very different street environments. Seven Dials is an example of a 'shared space' design which encourages all road users to use road space equally.

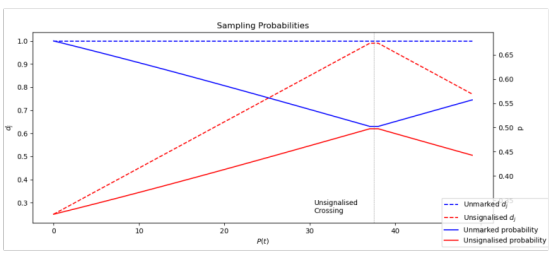
Model Purpose

This model generates pedestrian road crossing trajectories that are dependent on interactions between pedestrian attributes, road infrastructure and vehicle traffic. It is not a predictive model and instead provides a description, based on literature, of pedestrian road crossing behaviour. A descriptive model can be valuable when the phenomena of interest result from dynamic interactions that would otherwise be difficult to represent and for generating diverse future scenarios.

Modelling Framework

A sequential sampling modelling framework is used to model a pedestrian's gradual deliberation and choice between discrete road crossing options. This framework has been adapted from models of decision making used in quantitative psychology. It allows for spatially and temporally granular interactions between pedestrian and vehicle agents and heterogeneity in pedestrian agent's choice sets, both observed components of road crossing behaviour. The figures show the components of the model for an abstract environment, illustrated below.

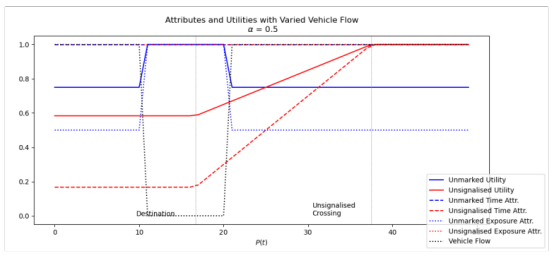
1. Sample a crossing option



In this scenario a pedestrian agent walks from point O to D. Their current position is P(t). They perceive two crossing options: an unsignalised crossing {P(t),R,S,D} and an unmarked crossing {P(t),Q(t),D}.

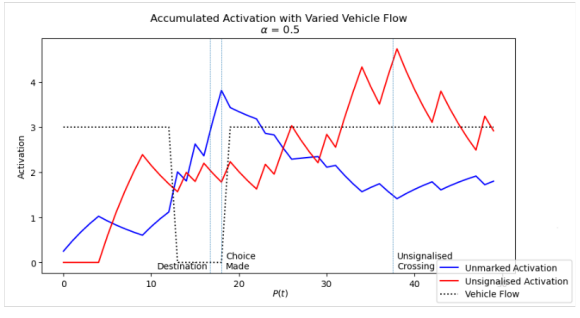
At each model step the agent samples a single crossing option. The probability of sampling an option is determined by its proximity to the pedestrian agent. This reflects the preference of pedestrians to use nearby crossing facilities and their limited planning horizon.

2. Perceive its utility



Once sampled, the pedestrian agent perceives the utility of the crossing option. The utility is given by a weighted sum of an indicator of journey time savings and of vehicle exposure avoided by using the crossing.

3. Accumulate activation

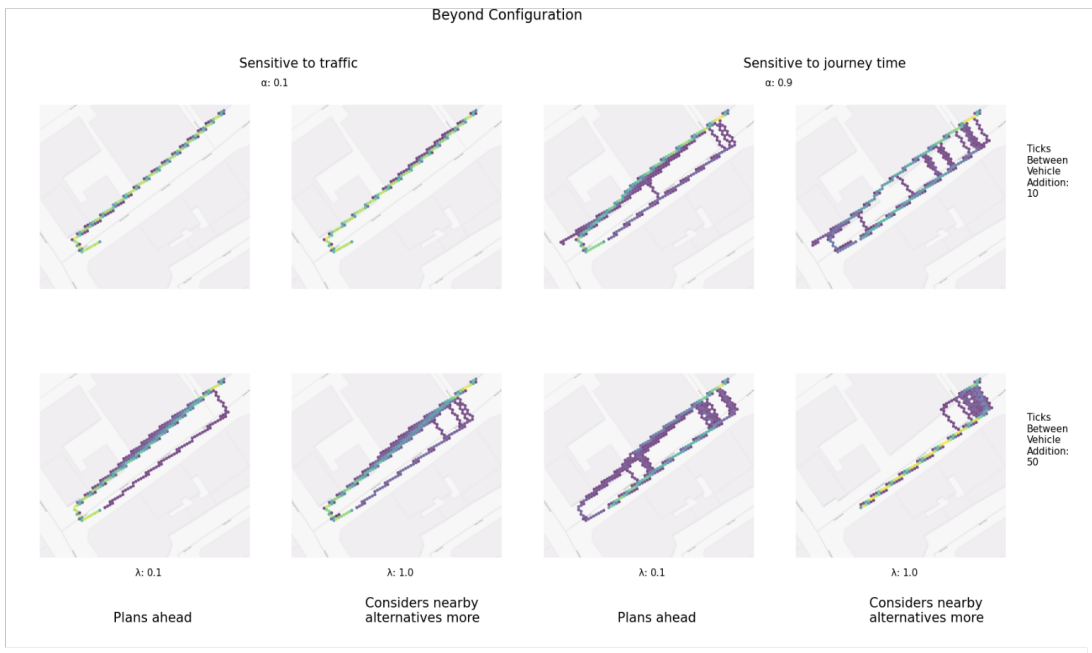


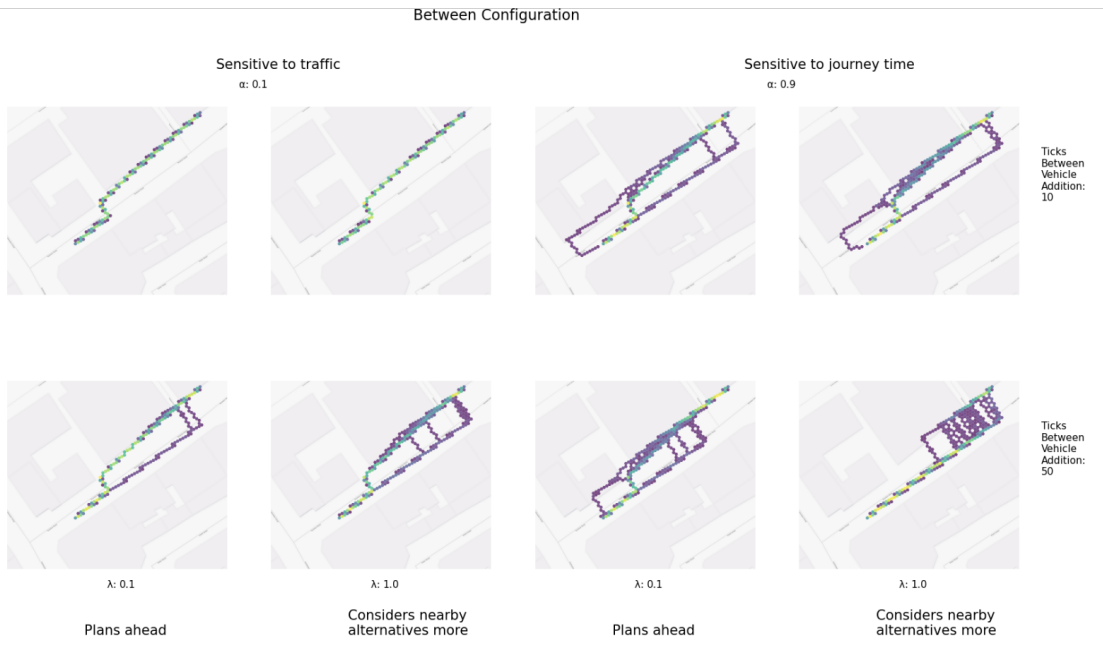
Each model step the accumulated activation for all options is decayed. The activation of the sampled option is increased by the value of its perceived utility. The figure indicates when the activation level triggers a choice. The unmarked (jaywalking) option is chosen, partly due to a drop in vehicle traffic.

Results

We implement this model in a geographic environment. Pedestrian agents are added to the model at the top right hand side of the road and walk to a destination on the bottom left. The figures show heatmaps of pedestrian paths for two crossing location configurations.

Different road crossing behaviours, ranging from highly compliant to highly jaywalking, are generated through the interaction of pedestrian characteristics, physical infrastructure and vehicle traffic.





casa

UCL

The Alan Turing Institute