1 Set up

1.1 Intro

We have reproduce the experiment with an agent model where reinforcement learning (defined in [1]. This is, we have studied a system of 20 agents where each one is characterized by its payoff, aspiration and probability to choose the cheap parking.
For every round, every agent chooses its action and it is determined which agents go to each parking. Then the agents collect the payoff and their probability to choose cheap is updated according to [1] .
There are four free parameters in this model that have to be set by us :

- Initial probability of choosing cheap: We have considered an empyrical point of view. The initial probability to choose cheap should be related with the number of seats in the parking. We have considered that this factor is slightly modified by the cost of both the cheap and expensive option.

$$p_{cheap,0} = S/N \left(1 + \frac{Q_{exp} - Q_{add} - Q_{cheap}}{M}\right) \tag{1}$$

- Initial aspirations: We have considered a normal distribution to represent the variability in a population like this one. The average and standard deviation of this distribution are:

$$\mu = M - Qexp - M/5 \qquad\qquad \sigma = M/5 \tag{2}$$

  Which means that 67 % of our agents will consider positive parking in the expensive one.

- Parameters learning (l) and habituation (h) have also to be modelled. In this work, we have considered $h = 0$, so aspirations are fixed for all the rounds. The learning rate, which measures how much an action changes our probability to choose it again, is $l = 1$.

1.2 Election for the free parameters

An important thing for choosing this free parameters is that an 80% of the participants were monotonous in the last five rounds. As a criteria for initial conditions, we have chosen to split the agents randomly between risky and non-risky agents:

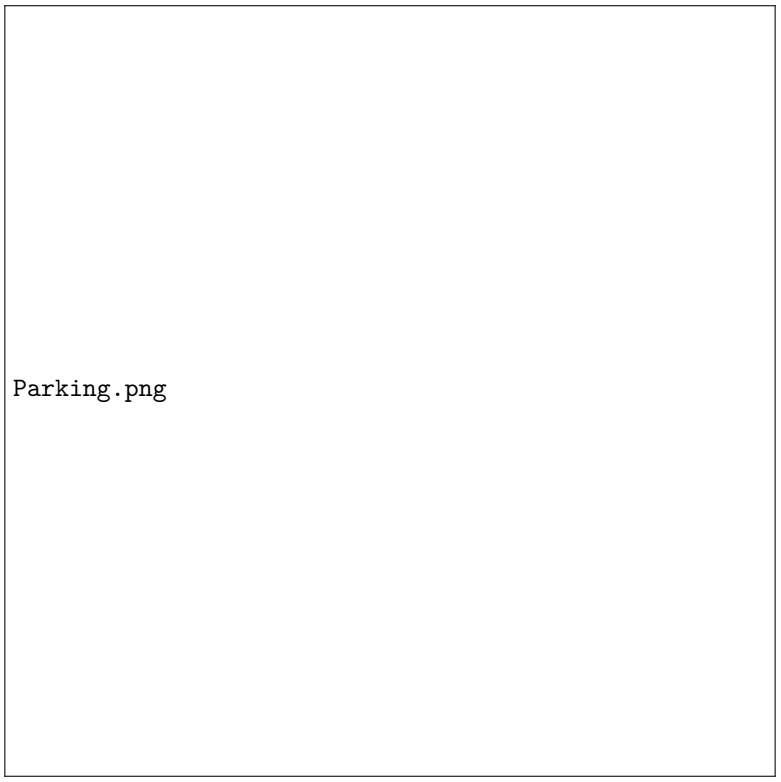
- Risky agents.- In the first step, they choose the cheap parking, and their initial aspirations are $A_i = M - Q_{cheap}$, this is getting a place in the cheap parking. The other payoffs just disencourage the subject.

- Non-risky agents.- In the first step, they choose the expensive parking, and their aspirations are $A_i = M - Q_{expensive} + \delta$,where $\delta = (Q_{exp} - Q_{cheap})/8$. This is just an election in order to introduce the ambition of changing from expensive to cheap.

We have to remark that this election is free and it has only been chosen because it produces nice results, but it needs a review in order to choose proper criteria.
Coming from this initial conditions, we choose l and h such that they produce agents that sustain their opinion and are similar to the ones in the experiment. We present the plot of the comparison: If we sum up all the differences between the experimental results and the reinforcement learning results the result is 7.33. The 50% of the agents sustain their opinion after the fifth round and the 30% of them choose the cheaper parking always.

References

[1] M. W. Macy, A. Flache, *Learning dynamics in social dilemmas*, Proc. Natl. Acad. Sci. USA **3**, 7229-7236 (2002).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