**Title**

*Simulating social influence dynamics from observational data: the case of secessionist flags in Barcelona's balconies.*

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**Abstract**

Different models of social influence have explored the dynamics of social contagion, imitation, and diffusion of different types of behaviour. However, empirical data on social influence processes have usually relied on surveys, virtual networks analysis or laboratory experiments, while few behavioural data indicating large social influence dynamics have been obtained from direct observation in 'natural' social contexts. This paper is based on a research project that provides precisely that kind of evidence in the case of the public expression of political preferences in the city of Barcelona during the years 2013-2014.

Since september 2012 a widespread social and political movement in Catalonia claims to organize a referendum on political independence from Spain. Secessionists have successfully called for several massive demonstrations in Barcelona, and have achieved the political support of the Catalan government for their claims. In this context, and since then, Catalan pro-independence flags have proliferated in Barcelona's balconies and windows. The act of hanging a pro-independence flag in your flat's balcony or window has become a very usual way of publicly expressing support for 'the process' (a term secessionists use to name the political and social road to independence).

The visual observation of flags in Barcelona's façades is therefore a chance to obtain direct and objective data on a social behaviour which has a simple binary structure (the options are to hang a flag or not to do it) and a very clear meaning (to express political preferences about 'the process'). It is also possible to analyze the distribution of flags in the visual space of the city in order to detect mechanisms of imitation or contagion. In fact, a preliminary observation of the main streets and avenues of the city confirms that

flags seem to appear together in clusters, and that the relationship between the frequency of flags and variables such as voting behaviour or income level is not obvious. In a pilot study during January 2013, we observed the distribution of flags in seven block's façades of one of Barcelona's main avenues, where big buildings with a large number of households are the norm, and a high number of flags were hanged. By calculating discrete probability distributions (DPD) of flags as a function of the observation window, we confirmed that observed distributions differ systematically from random distributions.

In order to confirm that a social influence mechanism is operating in the flags distribution, we have observed (during July 2013) the complete distribution of flags in a representative sample of 276 electoral districts in the city of Barcelona (almost one third of the total extension of the city); the sample includes 213,667 households in which 293,144 voters are registered. In a first stage of the project, we have studied the density of flags and how it correlates with the level of pro-independence vote in the 2012 election for the Catalan Parliament; it is then possible to observe that the hanging of a flag is to some measure inhibited in those electoral districts where there is not a clearly majoritarian pro-independence vote, while it is fostered in those where such a majority clearly exists. We then use a simple simulation model to reproduce the main trends of the distribution of flags in the space of the city buildings' façades. The model assigns agents a given probability of hanging a flag depending on their voting behaviour and calibrates this relationship using the sample data. Then the model introduces a simple social contagion mechanism by which the probability of hanging a flag raises when your neighbours do so. Comparing both types of simulation, we show that there is evidence of a non negligible effect of social influence among neighbours which explains the observed patterns better than the level of pro-independence vote alone.

In a second stage of the project, we selected a sub-sample of sixteen spatial areas (each one composed of six contiguous blocks' façades) in different electoral districts with different frequencies of flags. We then observed on the field the evolution and position of flags from 4 to 18 September 2013 (note that September 11th is Catalonia's National Holiday, and it is usual to hang a Catalan flag in the balcony that day); this observation allows to provide empirical evidence on the dynamics by which flags 'appear' before September 11th and 'disappear' afterwards, departing from a given pre-existing level of flags. A second simulation model is built in order to assess whether the specific spatial distribution of flags in the selected areas, as well as its temporal evolution,

systematically differs from the level of clustering that would be expectable by chance. Again, the model provides evidence that successive hangings of flags are not independent events and that there is some influence mechanism that favors the clustering of flags.