SimBologna: a spatial microsimulation and agent-based modelling approach to the analysis of citizens' participation to democratic innovations for a Greener Europe

Extended Abstract.

With the advancing climate crisis, the European Union (EU) is adapting to climate change through ambitious international cooperation and policies at the local and global institutional level. With the *European Climate Pact* and *The 2030 Climate Target Plan*, also known as the *European Green Deal*, the EU aims to facilitate and increase a transformative pathway where multiple Democratic Innovations (DI's) can join to address various areas of the Green Deal and harmonize joint efforts. In DI's, citizen's participation and civic engagement are key in the transition toward a climate-neutral society. Academic scholarship as well as the public sector and private industry are actively seeking understanding in how to maximize citizens' participation in DI's and how to foster citizens' adaptation of pro-environmental behaviors.

PHOENIX - The rise of citizens voices for a Greener Europe[1], is a Horizon 2020 EU-funded project that fully embodies this notion and aims to increase the transformative potential of DI's by conducting in-depth analysis of evidence-based best-practices (e.g., supporting citizens assemblies, public debate, conferences and public budgeting) for DIs in 11 pilots across 7 EU countries.

This paper demonstrates the stepping stones in developing a novel multimethod-especially for PHOENIX, where we focus on further understanding citizens participation in DI's by taking socio-cultural, environmental and different administrative levels into account. By means of a spatial microsimulation model using small-area data, we build data-sets on the neighborhood level to benchmark characteristics of individuals (Ballas, 2005). Using the results of the spatial microsimulation, we build an Agent-Based Model with GIS mapping to explore what enables and motivates citizens to adopt pro-environmental behaviors and join DIs, and analyze how implementation of various best-practices impacts both citizens participation and the success of DI's (Jager, 2021). Our approach has the potential to yield tailored and testable policy recommendations for the 11 empirical pilots in the PHOENIX project in particular, with a high transferability to DIs in general. This paper we demonstrate a prototype (work in progress) that we build for one of the pilots in PHOENIX, featuring the city of Bologna, Italy. In the models we zoom in the local culture of citizens participation in democratic innovations for climate change. The prototype is currently *under construction, tested and co-created* with partners in the PHOENIX consortium and local practitioners, citizens and other stakeholders in the pilot in Bologna.

The first stepping stone of our prototype features a spatial microsimulation model that combines small-area demographics form Bologna's census (that is nuts1 and neighborhood level data from the census (Comune di Bologna, 2022) with social-economic with

[1] https://phoenix-horizon.eu/

data from the European Social Survey (ESS) wave 8 from 2016 on Welfare attitudes, Attitudes to climate change featuring Public Attitudes to Climate Change, Energy Security and Energy Preferences (Fitzgerald, 2022). The spatial microsimulation approach involves an iterative reweighting of ESS data to fit in small-area descriptions from Bologna census data from 2021 and by using demographics and social economic characteristics form ESS as constraint variables. Microsimulation resembles a process in which one gives a weight to each individual, by adjusting the initial weight for each constraint variable through a reweighting algorithm (Ballas et al., 2005). We use the iterative proportional fitting (IPF) technique developed by Ballas et al. (2005). With of the microsimulation IPF approach we can map and investigate social-spatial patterns in attitudes to climate change and energy use on neighborhood level in Bologna. Currently we are verifying the integrity of the model in external and internal validity. Secondly, our approach also includes an empirically calibrated agent-based model that simulates socio-spatial dynamics in citizens participation to democratic innovations involving climate change issues in Bologna. This is important in cases where model results are used as inputs for policy-making (Ballas et al., 2013).

The second stepping stone of our prototype for Bologna features an agent-based model zooming in on the local culture of citizens' participation in democratic innovations for climate change in Bologna, but also the spatial-social dynamics at play that feed into citizen's willingness to participate to democratic innovations (Elstub & Escobar, 2019). In the model artificial residents of the city of Bologna are presented with an invitation to a citizens' assembly organized by local democratic innovation initiatives and decide whether they want to participate. In the model we focus on agents' cognitions, decision-making and social interactions in their quest to decide whether they are willing and motivated enough to participate in a citizen's assembly. For our agent-based model we choose to adopt the architecture of HUMAT that was developed for the purpose of a H2020 SMARTEES project[2] to model ten cases of social innovations diffusion in European cities (Antosz et al., 2019, Bouman et al., 2021). The HUMAT framework represents social influence in the context of the (dis)satisfaction of different needs and values as motives for action. Multiple needs can be grouped in the three basic categories of (1) experiential needs related to the short-term outcomes, (2) social needs related to fitting in the group and (3) values. Needs and values vary with respect to their importance to the individual. Moreover, alternative choices differently satisfy those needs and values. HUMAT also emphasizes individual differences in sensitivity to social normative influence - agents vary with respect to the importance of the social need. Depending on the satisfaction of the social need, information exchange can take two forms: signaling and inquiring. If the slightly preferred option is not popular enough among alters, ego signals to his/her most gullible alter with an opposite preference and tries to convince/inquire them to change their mind. If the strategy of signaling is not suitable to decrease the dissonance experienced by an agent, the agent chooses to inquire about the slightly preferred option. When inquiring, agents can ask the most persuasive alter in their social network for advice. Persuasiveness depends on perception of the communicating agent as being trustworthy as an information source, and is based

[2] https://local-social-innovation.eu/

on similarity between the communicating agents. Decisions on whether to adopt a certain behavior result from a cumulative (dis)satisfaction of needs/motives weighed by importance of each of those needs/motives.

We use the results from the spatial microsimulation to calibrate our agent-based model in spatial-socio-demographic characteristics of the resident population and in motives/needs of the residents to determine their willingness to participate in citizens assemblies and democratic innovations.

Results and discussion are expected to be ready by final submissions due in July 2023.

Keywords: Agent-Based Modelling, Spatial Microsimulation, Climate Change, Democratic Innovations, citizens' participation

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