Social Simulation Conference 2024

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Social Simulation Conference 2024

Book of Abstracts

The numbering of the abstracts corresponds to the numbering in the conference program

Key-note presentation: Simulation, Statistical Model and Analysis: keys to Higgs particle discovery at LHC

Elżbieta Richter-Wąs

On the 4-th July 2012, two large experiments at Large Hadron Collider (LHC) at CERN laboratory announced observation of new particle consistent with predicted by the so called "Higgs mechanism". The first fundamental scalar. This discovery came after several decades of awaiting for technologies to reach the point which could make it possible to confront with theoretical predictions formulated in 1964 by Peter Higgs The discovery came at half of the designed energy of the accelerator much more difficult experimental conditions than expected and only one-third of amount of data collected than originally judged as necessary. The key ingredient to this success was considered enormous effort of the community put into preparation of Monte Carlo simulations of the expected physics processes and detector responses, building adequate statistical models and development of statistical analysis methods which allowed to claim this discovery. In my lecture, after briefly reminding fascinating story of this discovery and measurements which followed, I will concentrate on presenting those key ingredients: simulation, physics modeling and statistical analysis methods used by the experiments at LHC.

Key-note presentation: Agent-based models of social dynamics. What for?

Guillaume Deffuant

In this talk, I review my experience in developing agent-based models of social dynamics and I discuss some strengths and weaknesses of the approach. I start with a model of farmer's decision to adopt, or not, environmentally friendly practices. This model includes various sources of data and initially aims at supporting policy makers' decisions. I contrast this type of models with more abstract models of opinion dynamics, which disclose unexpected emergent effects. Finally, I present recent models that led to an experimental work about a yet undetected cognitive bias. I conclude the talk with my view on some challenges that our field of research faces.

Key-note presentation: Exploring the World from the Bottom Up with GIS and Agent-based Models: Past, Present and Future.

Andrew Crooks

We have seen explosion in the availability of data along with utilizing such data in agent-based models. At the same time, we have seen a huge growth in computational power and the associating agent-based models to real world locations through the use of geographical information systems (GIS). This talk will explore how geographically explicit agent-based models have grown and evolved over the last 20 years taking advantage of the explosion of data and computational power. It will showcase a selection of applications of agent-based models and how they can be used to explore the world from the bottom up and with a specific emphasis on cities and regions. Through examples, I will demonstrate how GIS can be used to build agent-based models ranging from using spatial data to create the artificial worlds that the agents inhabit to utilizing demographic data to build synthetic populations. However, it is not just data that is important when building agent-based models but also how do we incorporate human behavior and theory into such models along with considerations of connecting agents through various types of social and spatial networks. While this might appear simple, there are many challenges associated with this which will be discussed using representative examples ranging from basic patterns of life to vaccination uptake. The talk will conclude with what opportunities are emerging in light of the recent growth in artificial intelligence (AI) with respect to building agent-based models.

Key-note presentation: Making modelling more consistent and efficient: standards are needed and fun

Volker Grimm

Insights and predictions derived from models often depend more on the modellers involved and their backgrounds, experiences and preferences than on the scenarios analysed. While this diversity cannot be completely reduced and has its advantages for exploring ideas, we need to find ways to make predictions more consistent if models are to support decision making. Adherence to certain standards in the modelling process would improve consistency. The word 'standard' has different connotations: just the way things are expected to be done in a particular

community, a way of achieving a certain level of quality, or a way of doing things that is imposed by certain regulations. Indeed, many standards have been proposed, but only a few are actually widely used and accepted, such as the ODD protocol for describing agent-based models. I will discuss the benefits and challenges associated with standards, and how standards taken together can help to establish a general Good Modelling Practice that makes models more consistent and fit for purpose. While standards are perceived by many as boring and an afterthought to modelling, I will show that standards can actually make modelling more efficient, enjoyable and rewarding.

1: Modeling dynamics of collective opinion on social media during the crisis of the Corona Virus Pandemic : A Hybrid Data-driven Agent based modeling Approach with Opinion Dynamics models and Bayesian Belief Networks

Morteza Mahmoudzadeh, Vahid Khalili Param and Parinaz Kiavash

Social media plays a significant role in shaping public opinion and idea flow, providing reliable data that sheds light on these dynamics. Understanding public opinion and cooperative behavior is crucial in determining the success and effectiveness of public policy. This is particularly relevant during crises, such as the Corona virus pandemic, where it is essential to comprehend people's views towards policy and the performance of governance institutions. However, the complexity of human behavior makes it challenging to mathematically explain these dynamics, resulting in essential processes being overlooked. To overcome this challenge, we adopted a data-driven strategy that extracts opinion and behavioral patterns from social media content. This allowed us to reflect society's average beliefs towards various topics, and we analyzed the sentiments of users for each subtopic. We then constructed a Bayesian belief network that demonstrated macro patterns of beliefs, opinions, information, and emotions, which impact responses towards prospective policies. Our goal was to understand the factors that influence opinion formation in society and improve the realism of simulations. To capture the dynamics of opinions in an artificial society, we used an agent-based opinion dynamics modeling approach. We aimed to investigate the practical implementation of this approach for policy analysis during the Corona Virus Pandemic Crisis. Our modeling approach can serve as a flexible data-driven policy-making tool to investigate public opinion on social media. Our overarching goal is to enhance the decision-making process by putting opinion dynamics in the context of collective decision-making, data-driven policy modeling, and digital democracy. To achieve this, we intend to use data-driven agent-based modeling as a comprehensive analysis tool to understand collective opinion dynamics and decision-making processes on social networks. Ultimately, we aim to utilize this knowledge to develop network-enabled policy modeling and collective intelligence platforms.

2: Generative Interpretation

Martin Neumann and Davide Secchi

The extended abstract investigates the question what is explained by an ABM and how an ABM explains. It argues that the traditional answer "from agents to structure" should be complemented by the answer "from interaction to meaning".

3: The effect of models of fugitive behavior on police interception strategies
Irene S. van Droffelaar, Jan H. Kwakkel, Jelte P. Mense and Alexander Verbraeck

One of the tasks of police is catching fleeing suspects, where the police interception positions depend on the fleeing suspect's route choices. Various conceptualizations of route choice decision-making of fleeing suspects exist. However, we do not know the effects of these different models of fugitive behavior on the calculated police interception strategy. Therefore, we operationalize two models of route choice and implement these in a simulation. Police interception strategies are obtained by optimization. The resulting sets of routes and the calculated police interception positions are subsequently compared and interpreted. The experiments show that the different route-choice models result in different escape routes and, therefore, different calculated police interception positions. The differences are larger when the road network is complex and contains non-uniform obstacles. In other words, the robustness of the calculated police interception positions for each model largely depends on the network topology.

4: Ruthless advocacy or avoidance of conflict? How argumentation styles affect consensus outcomes in groups with divergent preferences
Jonas Stein, Jan-Willem Romeijn and Michael Mäs

In groups where members deliberate with limited information, consensus can emerge where, under complete information, fundamental disagreement would prevail. Using an agent-based model, we explore the factors contributing to group consensus by comparing argumentation styles in two types of groups: agents in groups of advocates communicate arguments for options perceived as personally beneficial. Agents in groups of diplomats do the same but avoid disagreement in that they bring up arguments supporting a second-best option whenever their interaction partner finds worst what the sender finds best. Results show that consensus depends on argumentation style, but also on what members initially perceive as preferred. Diplomats are more likely to form consensus when initial perceptions accurately align with full information preferences, which diverge within the group. Conversely, and perhaps counterintuitively, in the presence of inaccurate initial perceptions, groups of advocates converge while diplomats part in disagreement. Our results imply that the ideal argumentation style must be considered carefully in light of both the desired outcome and the initial information distribution: when conflicting stakes produce a trade-off between consensus and truthful perceptions, polite versus selfish ways of deliberation may produce one or the other outcome, depending on the initial information members are equipped with.

5: Structural Sculpting: Making Inverse Modelling Generate and Deal with Flexible Structures
Lukas Schubotz, Emile Chappin and Geeske Scholz

Amidst parametric uncertainty and stochasticity, structural uncertainty remains a pervasive and unresolved challenge in agent-based models (ABMs). Scrutiny in building blocks used and implementation could alleviate at least some of the pressure, but efforts to provide reusable building blocks in a standardised form and repository remain nascent. This poses a great hurdle to robust decision making, policy evaluation, and theory building. Secondly, inverse modelling is a novel, explorative modelling approach: It is a conceptual method of iteratively posing forward problems for pattern-matching of given data. In this research, we propose to use inverse modelling on the building blocks provided by an ABM. We suggest a method for scrutinising ABM structurally by pattern-matching through inverse modelling in the case of solar panel adoption. Our method shows that it is indeed possible to vary and evaluate model structures automatically (and) via inverse modelling, and we suggest ways forward to sense-making and theory building through pattern mining as well as dealing with deep uncertainty. Thus, it is not an automation or replacement of the participatory modelling process, but an add-on to systematically reflect on structure and implementation of the ABM and theory to provide generative insights to social science.

6: Hill-Climbing or Satisficing: Does the Algorithmic Representation of Human Decision-Making in Agent-based Models of Organizations Matter?
Friederike Wall

Most agent-based models in the organizational sciences employ some variant of hill-climbing algorithms for representing human decision-making behavior. However, experimental research suggests that hill-climbing might not appropri-ately represent managerial behavior, while satisficing is an empirically relevant representation. Against this background, this paper takes a step forward to ex-plore the impact of the algorithmic representation of decision-making behavior on the results of agent-based models, especially for emerging macro-patterns. Based on the framework of NK-fitness landscapes, the paper employs an agent-based model of rudimentary organizations for distributed decision-making. The results suggest that switching from hill-climbing to satisficing shifts the trade-off between "stability and enhancement of search" to the latter. Moreover, for the macro-pattern "performance declines with increasing complexity" as emerg-ing from hill-climbing, the simulation experiments reveal mixed observations: Not only is satisficing considerably more sensitive to intra-organizational com-plexity; when local satisficers strive for global performance, the macro-pattern does not

universally emerge. These findings suggest that further research on how our agent-based models represent human decision-making behavior ap-pears necessary.

7: Episode Map for Stakeholder Engagement in Co-creating Modeling
Nagomi Sakai, Akinobu Sakata and Shingo Takahashi

Recent complex social issues necessitate greater stakeholder engagement throughout the modeling process and creating convincing simulations. So, co-creating modeling is essential. Moreover, creating a valid behavioral model and gaming is necessary for those issues so stakeholders can consider simulation and policies as one's own affair. Therefore, in this paper we proposed an Episode Map framework that captures the characteristics of stakeholders' behavior and values to solve this research gap. Using the information obtained from the Episode Map, we construct a simulation that reflects stakeholders' worldviews and behaviors and create a game in which stakeholders can recognize that there are agents who behave similarly to them. Also, we applied the prototype Episode Map to the case of Yawata City. As a result, we obtained much realistic qualitative information, which is difficult for researchers to grasp. Furthermore, we gained insights to improve a framework that can be applied in various regions and made improvements based on the findings.

8: Assessing resilience in a supply cocaine chain: an agent based modeling
Maykol Rodriguez Prieto

Drug market and trafficking are considered significant players due to the lucrative benefits generated by the production and distribution of drugs. One of the markets with significant growth in both demand and production is cocaine. Despite interventions through policies and campaigns, combating drug trafficking, such as crop eradication and interdiction efforts so far have not been sufficient to stem the flow of cocaine, and its market continues to rise globally. Understanding the illegal supply chain as an adaptive complex system I analyze why these are resilient. This research aims to model a generic cocaine supply chain through an agent-based model (ABM) following the approach used by Van Voorn et al., 2020 for a food system. I define the main agents involved in drug trafficking and their connections as a network, then I set different scenarios up and I expose those to two shocks based on law enforcement, removing actors from the market through arrests or seizing drugs from circulation, therefore I measure resilience according to Ulanowicz et al., 2008. The main factors to be assessed are the configuration of connections based on trust and the role secondary agents can play in the cocaine supply chain.

9: Relationship Between Family Grant Program and Social Inequality in Brazil: A Microsimulation Approach

Edgar Oliveira and Diana Adamatti

Brazil is the seventh most unequal country in the world and the first in income concentration. The relationship between social inequality and social and health problems is demonstrated through studies conducted by the scientific community using official data from international entities. Through a microsimulation, this study aims to demonstrate how much the Family Grant Program contributes to the reduction of social inequality in Brazil, and if an increase in the amount of the benefit could still reduce it, using data from official government entities to reproduce Brazil's characteristics. The microsimulation suggests that the supply of the Family Grant causes a reduction of 0.037 in the Gini Coefficient, and the increase of its value can possibly reduce the Gini Coefficient by up to 0.074. The microsimulation also suggests that Family Grant Program has a immediate impact, serving as a mitigator in times of economic crisis.

10: Bringing Life Cycle Thinking to Social Simulation: Empirical Agent-based Simulation of the Sustainable Diffusion of Circular Business Models

Ryu Koide, Shinsuke Murakami, Haruhisa Yamamoto and Keisuke Nansai

Social simulation using agent-based modelling (ABM) is a promising approach for modelling circular economy practices, which play a significant role in achieving the United Nations Sustainable Development Goals. The complex system behaviours associated with product life cycles make it necessary to incorporate life cycle thinking into social simulations. This study expands the ABM of the diffusion of circular business models focusing on consumer behaviours using original survey data derived from users of refrigerators and laptops. Further, it proposes a method to set parameters for both consumer and product behaviour rules to model the diffusion of circular business models. Employing scenario analysis and Morris sensitiv-ity analysis, this study analyses effective strategies and critical parameters for the diffusion of two circular business models (refurbishment and leas-ing services), and their consequences for sustainability impacts. Our results reveal the significant roles of the promotion strategy in stimulating social influences, which can be combined with price and other strategies to achieve circular model adoption by up to 20–44% of the population. In addition, the prolong strategy was important for product longevity and greenhouse gas emission reductions. The methodology proposed in this study opens up the future application of ABM to support decision-making for the transition to a sustainable circular economy.

11: On the effects of decision-making modes on organizational resilience
Stephan Leitner

This paper examines the influence of decision-making modes on organizational resilience, particularly how these modes affect an organization's capacity to withstand and recover from shocks. Amidst increasing occurrences of economic and operational shocks, understanding the efficacy of organizational structures in crisis situations is crucial. Using agent-based modeling, this study simulates various decision-making mode to evaluate their performance before and after induced shocks. The findings demonstrate that collaborative and hierarchical decision-making modes generally enable organizations to maintain or exceed pre-shock performance levels, especially in less complex task environments. In contrast, silo-based and sequential modes often hinder recovery in more complex settings.

12: A two-levels game structure to link IAM with ABM for social-tipping investigation in climate change mitigation policy support
Adrien Poujon

Critics have long highlighted Integrated Assessment Models' (IAMs) shortcomings in representing sociotechnical complexities. To address this, I propose a hybrid model blending elements of IAMs and agent-based modeling (ABM). Drawing upon JUSTICE, a simple stylized IAM inspired by RICE50+, and taking normative insights into consideration, this approach employs a two-level game structure inspired by Putnam's work, integrating regional household dynamics and international negotiations. By simulating climate-economy-policy feedback loops and their influence on household opinions, this model aims at investigating the intertwining of policy choices driven by both global negotiations and local constituencies. This presentation outlines the model's structure and initial findings, demonstrating its potential to offer nuanced insights into climate policy formation within a compact framework.

13: Perceived and Actual Opinion Polarisation in the German Climate Change Debate
Peter Steiglechner, Paul Smaldino and Agostino Merico

The debate about climate change seems to have become increasingly polarised in the last decade, which may constitute a significant barrier to our efforts addressing the climate crisis. Many approaches to measure polarisation in society do not differentiate between perceived and actual polarisation, and when they do, they often conflate ideological and affective polarisation. Here, we present a new method to measure perceived ideological polarisation by formalising mathematically how individuals perceive the opinions of others. We account for the fact that these perceptions co-evolve with opinions in society and depend on political identities. Applying

this method to data on climate opinions among Germans, we find that, even in the absence of any affective or structural drivers, people may in general perceive much more polarisation than their actual opinions suggest. However, this varies greatly among different partisan groups. Our method and analysis offer a fresh perspective on (mis-)perceived ideological polarisation and can be applied to simulated or empirical data covering various topics. Our conclusion—that Germans may overestimate the degree of ideological polarisation within the climate debate—is a relevant consideration for social cohesion in climate politics.

14: The Echoes from Social Media Platforms: an agent-based model
Cristina Chueca Del Cerro

Echo chambers is the social media phenomenon where like-minded individuals communicate primarily with each other, exchanging information that supports their pre-existing opinions. Recent debate in political sciences has focused on whether these echo chambers are present and their polarising effects. Yet, it neglects the role of the social networks over which this process can occur. We built an agent-based model that compared different network configurations and information selection regimes to explore this interaction. Our scenarios varied the amount of opinion homophily in the personal network and the level of exposure to confirming information. The preliminary results suggest that artificially creating echo chambers at the start of the simulation did not guarantee their persistence over time. Moreover, information filtering is not sufficient to sustain echo chambers in the absence of homophilous communities. This research offers both a theoretical framework for understanding echo chamber emergence and empirical evidence regarding this process and its effects on polarisation.

15: ABMs over networks: parameterising Hamill and Gilbert's (2009) Social Circles
Cristina Chueca Del Cerro and Jennifer Badham

Agent-based models are often used to explore dynamic processes such as diffusion over networks. Researchers have developed various generators that emphasise different aspects of network structure. Hamill and Gilbert's (2009) Social Circles is one such generator but published work has only created networks with basic settings. Here we assess the viability of Social Circles as a general network generator, and how the network structure arises from algorithm parameters. We explore the parameter space by varying the distribution of social reach, which is responsible for edge creation in the model.

16: Modelling Financial Rumours: An Agent-Based Modelling Approach
Archana Narayanan and Vijaya Bhaskar Marisetty

Rumors in financial markets impact investors' decisions, driving asset prices away from their fundamental valuations. From a regulatory perspective, it is challenging to contain them. We develop an agent-based model to under-stand the price discovery process in a simulated stock market that allows heterogeneous agents, who differ in cognition and financial literacy, to in-teract for price formation. We find that both cognition and financial literacy are important determinants of rumor spread in stock markets: Higher (lower) cognition and higher(lower) financial literacy reduce (increase) rumor spread. Given that regulators cannot control agents' cognition, our results suggest that investing in financial literacy can help contain rumors.

17: Multi-Agent Reinforcement Learning for Market Competition in Mobility Services
Haruki Sato, Fujio Toriumi and Yukihisa Fujita

Service quality is strongly related to user satisfaction and is an essential factor for service providers to develop marketing strategies. In the case of mobility services, a number of new services have appeared in the last decade as a result of the MaaS trend, and new marketing strategies are required in order to survive against the competition and acquire users. In this study, we conduct a multi-agent simulation for mobility services to reveal how service quality influences user acquisition. The model of the simulation contains two types of agents, service providers and users, which are subjected to reinforcement learning toward each other. The simulation results demonstrated the following:(1) Users tend to prefer services with high availability. (2) Less popular services can acquire a certain number of users by differentiating themselves from the dominant service. (3) Services can attract and retain a large number of users by running campaigns during their launch.

19: Integrating Real-World Data into Agent-Based Models for Urban Cyclist Exposure
Rok Novak, Maria Alejandra Rubio Rojas, Davor Kontić, Janja Snoj Tratnik and David Kocman

This extended abstract outlines the development and application of an agent-based model (ABM) to assess the exposure of cyclists to air pollution and noise in urban environments, focusing on Ljubljana, Slovenia. The ABM is enhanced by integrating data from wearable sensors and ethnographic methods to capture the decision-making processes and behavior of cyclists. This data collection, beginning in April 2024, aims to provide insights into how cyclists' route choices and exposure to pollutants are influenced by environmental factors and urban infrastructure. The project employs participatory modeling techniques to involve stakeholders, including policymakers and urban planners, ensuring the model's applications are effectively tailored to

community needs. The ABM utilizes data from ongoing studies, including physiological and environmental monitoring, to assess exposure levels and validate the model's assumptions. This approach aids in refining the model, with further iterations expected to enhance its predictive accuracy and utility for urban planning. By the end of 2024, the project aims to deliver a validated and refined model that can guide urban development and transport policies towards more sustainable and health-conscious solutions. The study demonstrates the potential of ABMs in urban planning, providing a robust framework for evaluating the health impacts of cycling in urban areas.

20: Organizational Supercompensation? Could Alternating Familiar and Challenging Conditions Benefit Individual and Organizational Fitness?

Fred Ingram and Dinuka Herath

Although organizations have always needed to respond to changes in their environment, with the current high corporate mortality rates there is much interest in how an organization can survive in highly unstable and unfamiliar environments. In practice, the level of environmental dynamism fluctuates between stability and instability periodically or sporadically, with the magnitude, frequency, unpredictability, risks, and nature of such fluctuations rapidly increasing in recent times. Our focus is on how an organization can survive such fluctuations. It is well-documented that humans and other organisms can benefit from some environmental variation, as in training regimes where increased intensity or new activities followed by a period of rest and recuperation can lead to improved health and performance. To investigate whether this is possible for organizations also, we developed an agent-based model that simulates project-oriented organizations with individuals interacting, completing tasks, and developing skills. The model illustrates how organizations exposed to periodic episodes of familiar stable and unfamiliar unstable external entropy levels can, under specific conditions, recover and maintain or improve performance. This research contributes to understanding how organizations adapt and thrive in dynamic environments, offering insights for managers navigating extreme variations in external entropy levels.

21: Does Fair Value Accounting fuel Market Instability - Simulative Evidence from a Cobweb Model

Eduard Braun, Christian Hirschmann and Janis Kesten-Kühne

In this work, we study the relationship between the accounting prin-ciple and the (in)stability in a cobweb model with an endogenous number of sup-pliers and a representative demand. While all share the same quadratic cost func-tion, suppliers are heterogenous in their adaptive price expectations. Introducing accounting into the model, we compare the results with fair value vs.

historical cost accounting ceteris paribus in different settings. First results suggest that fair value accounting increases instability measured by the standard deviation of pe-riod prices. We argue that this might be extrapolated to real cyclic markets.

22: Exploring high-in-sugar food purchasing in Chile: an agent-based model of social determinants of health

Yanela Aravena, Anja Heilmann, Richard Watt, Tom Broomhead and Georgios Tsakos

This agent-based model explores the changes in the purchasing behaviour of high-in-sugar products over time. The model is loosely based on the Chilean population and the impact of nutritional policies implemented in the country in changing eating behaviours associated with obesity and chronic diseases. It is comprised of two types of agents: (1) Individuals with a daily food budget and price sensitivity who decide on their preferred food type (high or low in sugar) based on their nutritional knowledge, food taste, social networks and the effect of advertising over them; and (2) stores that sell high and low in sugar products at different prices and restock based on the demand of their products. Individuals can change their preferences over time based on previous purchasing choices, price sensitivity, the purchasing choices of their friends, and the availability of products. The model is currently in the final stages of building. Parameter estimation, calibration, and validation of the model are still pending.

23: Exploring the complex behaviours of electric vehicle drivers based on an Agent-based Reinforcement Learning method

Zixin Feng, Qunshan Zhao and Alison Heppenstall

The rollout of electric vehicles (EVs) is considered as an efficient way to enhance transportation sustainability. Understanding the charging demand of EVs is therefore necessary for future deployment of charging infrastructure and the increase of EV adoption rates. Previous studies have used either data-driven or simulation-based approaches to understand EV driver behaviours and estimate their charging demand. However, these studies are limited in representing the adaptability and learning ability of EV drivers when making charging choices. To address these challenges, we introduce an agent-based reinforcement learning (RL) framework to simulate EV drivers' charging and routing choices and the resulting public charger usage pattern in Manchester. The model is validated using real-world charging session data. We found that charging activity is not an everyday necessity for normal intra-city EV drivers unless the number of trips significantly increases their total trip distances, or when the battery charge falls below the drivers' psychological threshold and incentivise their range anxiety. This modelling framework can contribute to a better understanding of the adaptive charging behaviours of EV drivers and their charging demand distribution in road networks.

24: Text, interviews, and expert coding: Using qualitative and quantitative data in an agent-based model of compliance with Human Rights judgments
Katharina Luckner, Adarsh Prabhakaran, Ula Aleksandra Kos, Aysel Küçüksu, Thorbjørn Lundsgaard and Veronika Fikfak

We develop an agent-based model to investigate the mechanisms that determine state compliance with European Court of Human Rights judgments. Tasked with upholding the European Convention on Human Rights, the Court sanctions human rights violations. The Council of Ministers oversees the state-side implementation of remedies in response to the judgments rendered by the Court, as states determine these remedies themselves. To increase compliance with Court judgments, we must understand why some cases remain unenforced, while others are complied with, how states pick remedies and learn from each other. To that end, we use quantitative and qualitative data collected by the ------------ project to construct an agent-based model that connects individual state behaviour with the overall outcome of many compliance processes running in parallel and includes learning processes between states.

25: Partisanship, Polarization and Preferences: An Agent-Based Model of Sorting
Weize Zhao and Gordon Brown

Growing concern surrounds the profound sorting of the American public into distinct Democratic and Republican groups. Counter-partisan members now diverge across not only political issues but also various non-political dimensions. This chapter presents an agent-based model that simulates the phenomenon whereby individual attitudes not only polarize along each singular dimension but also exhibit cross-dimensional correlations, encompassing both related and unrelated issues. Our model assumes that the dynamics of individual attitudes are influenced by the drive to uphold group identities. Through model simulations, it is shown that population sorting occurs under two necessary conditions: when individuals prioritise their party's stance over personal judgments, and when an overemphasis on attitudes from a single dimension distorts group classification. The model comprehensively accounts for phenomena like consensus, polarization, and social sorting. Additionally, it introduces a novel identity-based decision-making assumption, as motivated by the psychological literature but not typically employed in prevailing computational models of attitude dynamics.

26: Context-sensitive game players: How context-specific expectations affect the emergence of group conflict, peace, and dominance in Hawk-Dove and Nash Demand
Christopher Watts and S M Amadae

Following recent models of emergent social discrimination and group dominance in the Hawk-Dove and Nash Demand games, we examine the impact of giving agent players the ability to recognise different contexts, and maintain context-specific beliefs which then determine their actions in those con-texts. Whereas previous models assumed agents belonged to two distinct groups, and had universal knowledge of who belonged to which group, we represent agents with initially heterogeneous contextual models for determining which action to expect from each opponent. We find that group-like pat-terns emerge whereby agents with similar attributes tend to have similar experiences during game play, and respond in similar ways with their actions. We also find that outcomes vary with the number of contexts agents are able to distinguish, and with the rate of revision of these context models. In common with previous models, outcomes also vary with a structural property of the game, namely its mixed strategy Nash equilibrium (MSNE). Depending on these factors, agents may experience regimes of predominantly all-against-all conflict, peace, or one group dominating another.

27: A Topology of Complex Systems
Davide Secchi and Martin Neumann

This paper is an attempt to understand and distinguish between different types of complexities. The basic assumption is that complex systems are not all the same, in the sense that they may share similar properties, but they manifest themselves differently and in varying degrees. This results in systems that can be called complex --- for example, a beehive and a football team --- but are indeed different from each other. The question what makes them different is notoriously difficult to answer. For this reason, in this paper, we take a generative approach that isolates aspects of complex systems and adds them sequentially to a (simple) base computational model. In this way we aim at mapping complexities as they are generated on a step-by-step sequential basis from the computational add-on models. The result is that of observing how features of complex systems come to life depending on which characteristic is switched `ON' in the model. This should contribute at developing a topology of complex systems.

28: Integrating Behavioral Insights into Agent-Based Models of the Energy Transition
Lynn de Jager, Liesbeth Claassen, Emile Chappin and Geeske Scholz

How decisions of households influence the energy transition is increasingly be-ing studied with the computational tool of agent-based modelling. For a realistic simulation of agent decisions, it

is crucial to draw on theories from social psy-chology that describe human behavior. A good fit between behavioral theory and household energy decisions simulated in agent-based models (ABMs) improves the validity of the results generated with such models. This research seeks to in-tegrate behavioral science in an agent-based model in order to yield insights that can be used to steer the energy transition. We have first performed a systematic literature review of energy transition ABMs to get a better understanding of what behavioral theories and justifications have been used in existing ABMs of the energy transition. Another systematic literature review was conducted to identify what households experience as drivers and barriers to the adoption and use of heat pumps. We will draw on the insights of both reviews to build an ABM of household energy technology adoption and use to explore the influence of house-holds on the energy transition.

29: To Eat or Not to Eat: Modeling Food Loss and Waste Behavior at a Hotel Breakfast Buffet
Ivan Puga-Gonzalez, Patrycja Antosz, Ernesto Carrella, Elisa Lori, Caterina Rettore, Markus G. Rousseau, F. Leron Shults, Matteo Vittuari and Larissa Lopes Lima

In this study, we present an agent-based model that incorporates a psychologically realistic repre-sentation of food waste behavior in individuals at a commercial establishment. This model is developed within the framework of the EU HORIZON CHORIZO project, which seeks to en-hance our understanding of how social norms influence behaviors related to food loss and waste (FLW). Building upon the HUMAT model—a socio-cognitive architecture in which artificial agents possess diverse motives (social, experiential, and values-based) underlying their behavior-al decisions—we aim to address limitations by integrating the Motivation, Opportunities, and Abilities (MOA) framework from the social sciences. Our model consists of a simulated popula-tion (e.g., guests in a restaurant, hotel, or cafeteria) with access to a buffet. Individuals follow rules influenced by their motivations, opportunities, and abilities, which dictate factors such as the timing of their meal, portion sizes, frequency of servings, and amount of leftovers on their plates.

30: Vahana.jl - A framework (not only) for large-scale agent-based models
Steffen Fürst, Tim Conrad, Carlo Jaeger and Sarah Wolf

Agent-based models (ABMs) offer a powerful framework for   understanding complex systems. However, their   computational demands   often become a significant barrier as the number of agents and   complexity of the simulation increase. Traditional ABM   platforms   often struggle to fully exploit modern computing   resources,   hindering the development of large-scale simulations.   This paper   presents Vahana.jl, a high performance computing open

source framework that aims to address these limitations. Building on the formalism of synchronous graph dynamical systems, Vahana.jl is especially well suited for models with a focus on (social) networks. The framework seamlessly supports distribution across multiple compute nodes, enabling simulations that would otherwise be beyond the capabilities of a single machine. Implemented in Julia, Vahana.jl leverages the interactive Read-Eval-Print Loop (REPL) environment, facilitating rapid model development and experimentation.

31: The Adoption of Pro-Environmental Behaviour: Can Dynamic Norms Explain How Small Scale Change Leads to Large Scale Change?

Fernanda Reintgen Kamphuisen, Thijs Bouman, Ellen Van der Werff and Nanda Wijermans

Counteracting climate change and other environmental problems requires large-scale adoption of pro-environmental behaviour (PEB). However, many PEBs are still minority practices, only being adopted at small scale. A key question therefore is: How can small-scale PEBs become majority practices? Whereas previous research identified that individuals may adopt behaviours that they perceive others to perform, such descriptive norms may backfire when the desired behaviour is performed by a minority (i.e., weak descriptive norm). We explore what factors determine whether people adopt PEBs despite a weak descriptive norm, focusing on personal environmentalism (i.e., environment self-identity) and perceived trends in society (i.e., dynamic norms), and how these may eventually lead to a strong descriptive norm for PEB. Applied to the adoption of electric vehicles (EVs), we test these propositions via an empirically informed agent-based model showing that the relationships of (factors of) EV adoption, dynamic and descriptive norms form a dynamic interplay that can explain how EV adoption of a minority can lead to large-scale changes. Limitations and implications will be discussed.

33: Gaming Polarisation: Using Agent-Based Simulation as a Dialogue Tool

Shaoni Wang and Wander Jager

Amidst the backdrop of multifaceted challenges, the escalation of polarisation and societal instability stands as a paramount concern. Highlighted in the 2024 Global Risks Report by the World Economic Forum, misinformation and disinformation emerge as imminent threats propelled by technological advancements. Acknowledging the urgency to comprehend the drivers of global polarisation, our study endeavours to delve into its dynamics, unveiling underlying causes and promoting inclusion within a democratic framework. Leveraging the agent-based HUMAT framework, we aim to develop a dialogue tool that aids in understanding the intricate dynamics and potential risks of polarisation. This tool holds promise for applications in educational settings, providing valuable insights into navigating complex social dynamics.

Educators equipped with this model can illuminate social influence, conformity, and opinion dynamics to foster a more informed, collective-thinking society.

35: How to get people to leave: Exploring the influence of warning message informativity on the evacuation of large-scale events

Ruth Meyer, Amelie Schmidt-Colberg, Antonio Kruse and Corinna Koepke

This paper outlines work in progress on the development of an agent-based model (ABM) of large-scale events employed to investigate the significance of warning message informativeness in the context of evacuations. Unlike other disaster scenarios where the detail within warning messages has been shown to impact response times and decision-making, the effectiveness of such informativeness in large-scale event settings remains underexplored. Our preliminary results indicate that warning message informativity can have a significant effect on decision and evacuation times but other influences on human behaviour such as environmental or social cues also need to be taken into account.

36: Death, Taxes and Inequality: Can a Minimal Model Explain Real Economic Inequality?

John Stevenson

Income inequality and redistribution policies are modeled with a minimal, endogenous model of a simple foraging economy. Significant income inequalities emerge from the model for populations of equally capable individuals presented with equal opportunities. Stochastic income distributions from the model are compared to empirical data from actual economies. The impacts of redistribution policies on total wealth, income distributions, and inequality are shown to be similar for the empirical data and the model. These comparisons enable detailed determinations of population welfare beyond what is possible with total wealth and inequality metrics.

37: A Kaleckian kaleidoscope – a new perspective of UK dynamics

Simon Greaves

Michal Kalecki left a body of work explaining the dynamics of investment-led economies and generation of business cycles which is proven relevant today by testing his theory while evaluating the UK economy's performance over the past 50 years. His dualist approach with a pair of actors amid business and political cycles can be updated to model a more modern economy with the additional application of methods such as elements of game theory and agent-based modelling to avoid shortcomings of the traditional classical approach. They relied on flawed market-clearing equilibrium determination. It is possible to acknowledge yet sidestep

nearly 100 years of commentary on Kalecki's important concepts and fast-forward to a formulation that builds on the latest and best available neo-Kaleckian model to show the relationships between key variables driving cycles and growth today, relationships that can better be understood through the lens of gaming choices and behavioural economics rather than in the limited light of marginal choice analysis based on differential equations.

39: Terrasim : An Agent-Based Simulation for systemic policy evaluation. Application to electricity mix transition

Tristan Bersoux, Mael Franceschetti, Cédric Herpson and Jean-Daniel Kant

We present an Agent-Based Model aimed at evaluating policies, calibrated on national accounts, with a use case on French electricity mix transitions. It incorporates ecological, social, and economic impacts for a systemic analysis. First results highlight the challenges and feasibility of transitioning to more sustainable energy sources, and supports our general approach. Future work aims to refine the model, develop its energy sector, and details other sectors of activity.

40: Likelihood-Based Methods Improve Parameter Estimation in Opinion Dynamics Models

Jacopo Lenti, Corrado Monti and Gianmarco De Francisci Morales

We show that a maximum likelihood approach for parameter estimation in agent-based models (ABMs) of opinion dynamics outperforms the typical simulation-based approach. Simulation-based approaches simulate the model repeatedly in search of a set of parameters that generates data similar enough to the observed one. In contrast, likelihood-based approaches derive a likelihood function that connects the unknown parameters to the observed data in a statistically principled way. We compare these two approaches on the well-known bounded-confidence model of opinion dynamics. We do so on three realistic scenarios of increasing complexity depending on data availability: (i) fully observed opinions and interactions, (ii) partially observed interactions, (iii) observed interactions with noisy proxies of the opinions. To realize the likelihood-based approach, we first cast the model into a probabilistic generative guise that supports a proper data likelihood. Then, we describe the three scenarios via probabilistic graphical models and show the nuances that go into translating the model. Finally, we implement such models in an automatic differentiation framework, thus enabling easy and efficient maximum likelihood estimation via gradient descent. These likelihood-based estimates are up to 4x more accurate and require up to 200x less computational time.

41: Blueprinting Organ Donation: A Policy-first Approach for Developing Agent-based Models

Michael Belfrage, Christopher Frantz, Bertilla Fabris and Fabian Lorig

Agent-based models have long been argued a useful tool to support policy analysis, variably targeting the assessment of policy design, as well as establishing its performance. Challenging, however, remains appropriate empirical parameterization and validation of such models. This paper contributes to the development of rigorous accounts of policy modelling primarily driven by policy documents in order to develop general conceptual model. Such models can then serve as a basis for early validation by subject matter experts, but more importantly, inform the subsequent inquiry relevant for the parameterization of such models, while at the same time offering the opportunity to detect deviations from regulated practice. Relying on the scenario of organ donation based on the Swedish legislation, we explore the merits of such an approach, and sketch the individual steps from policy documents to conceptual model. Supporting the methodological process, this paper employs the Institutional Grammar 2.0, which offers selected features supporting the proposed modelling approach.

45: Optimal Placement of Healthcare Facilities Based on Patient Attractiveness Assessment

Kazuhito Matsushita and Setsuya Kurahashi

The paper centers on optimizing clinic placement for sustained growth and survival. Recognizing the urgency of addressing diverse regional healthcare needs efficiently, the study considers the impact of perceived "attractiveness" from the patient's perspective on clinic success. The research aims to understand patients' decision-making processes in selecting healthcare institutions through real-world surveys and evaluate optimal clinic placement using attractiveness assessments. The methodology involves dividing the analysis area into 500-meter meshes and synthesizing resident and household information from aggregated population data. The number of patients for specific conditions is estimated utilizing prescription data at municipal and mesh levels. A questionnaire survey employing the Analytic Hierarchy Process (AHP) explores patients' preferences for healthcare institutions. Distances from existing competitor medical facilities and a hypothetical clinic are estimated by incorporating AHP-derived attractiveness into the Huff model. Ultimately, the simulation model is expected to identify optimal locations for new clinic openings, providing valuable support for physicians in enhancing clinic management and sustaining operations amidst the dynamic healthcare landscape.

46: Neural Surrogates of Agent-Based Models to Learn from Micro-Data
Francesco Cozzi, Corrado Monti, Marco Pangallo, Alan Perotti and André Panisson

Agent-Based Models (ABMs) are widely used to study complex systems. By defining a stochastic, microscopic dynamic, they allow to draw macroscopic implications on the system as a whole. However, since ABMs follow a model-based approach and are often not differentiable, it is difficult to use micro-level data to estimate the set of rules, latent variables, or parameters of an ABM. Automatically representing an arbitrary ABM as a differentiable program, akin to deep learning models, could pave the way to solve this issue, e.g. estimating their parameters and improving their connection with real-world data. In this work, we propose a differentiable, surrogate model that can approximate an unknown ABM's micro-level dynamic. To do so, we devise a generative model consisting of a Latent Diffusion coupled with a Graph Neural Network. We train the model with synthetic micro-level data from the Schelling Segregation model. The surrogate is able to reproduce the original rules of agent behavior: we observe that the distributions of the samples generated closely match those of the original ABM. Finally, we find that the surrogate model can reproduce the macroscopic behavior of the original model, leading to segregation patterns over time.

48: Outlining some requirements for synthetic populations to initialize agent-based models
Nick Roxburgh, Rocco Paolillo, Clémentine Cottineau, Tatiana Filatova, Mario Paolucci and Gary Polhill

We outline some principles for requirements of agent-based models for synthetic populations. The challenge posed by agent-based modelling to synthesizing appropriate populations is derived from the multiple features agent-based models should bring together in a simulation. These include, but are not limited to: attributes of agents, their location in space, the ways they make decisions and their behavioral dynamics. In the real-world, such aspects of everyday human life are interlinked. Initializing synthetic populations in ways that fail to respect these covariances arguably influences the conclusions we draw from models, which, where models are used as part of decision-making processes, could lead to systemic biases.

49: Situational Data for Agent-Based Modelling
James Allen, Corinna Elsenbroich and Mark McCann

Agent-based modellers often bemoan the unavailability of the "right kind of data" for ABM. In turn, one purpose of ABM is often seen as suggesting new kinds of data collection. This paper reports on a model built iteratively with stakeholders, taking the idea of collecting context and

situation specific data seriously. The model represents stress and loneliness experiences of adolescents in schools, focusing on spatial, temporal and agent interaction dynamics.

50: Money as a mechanism of generalized cooperation: an agent-based model
Eduardo Ferraciolli, Tanya Araujo, Francesco Renzini and Flaminio Squazzoni

Large-scale societies, where most interactions are anonymous, dispersed and fragmented, pose great challenges for sustaining cooperation. Direct and indirect reciprocity, which have been extensively studied as possible cooperation-promoting mechanisms, present well-known limitations: both are informationally demanding (whether they rely on interpersonal memory and reputation), potentially sensitive to noise and error, and subject to cyclic instability and defection cascades. Building on recent findings from fundamental monetary theory and experimental economics, in this paper we develop a novel agent-based model exploring an alternative mechanism that can be understood as fostering cooperation: the institution of money. Our illustrative model demonstrates that "money" - conceptualized as an exchange of countable tokens, or as changes in balances marked on a reliable ledger - sustains cooperation in societies of strangers, even when competing with other well-known cooperation-enhancing strategies, such as direct and indirect reciprocity. We use the model to evaluate evolutionary stability, overall cooperation rates, and population size effects for different setups in which these strategies compete for survival, concluding with a discussion of implications for social and monetary theory.

52: Health-Economic Synergies of Carbon Emission Reduction Policies
Ting Xie

In response to the challenges posed by climate change, the European Union (EU) formally adopted the Carbon Boundary Adjustment Mechanism (CBAM) in 2022. Developed countries have also taken steps towards introducing similar legislative frameworks. It therefore remains to be seen whether China is equipped to deal with the potential consequences of these changes. Using a Stock-Flow-Consistent macroeconomic model, this paper explored the potential health-economic synergies under 13 scenarios in 2019–2100, including three climate mitigation policies (tightened quotas in carbon emission trading market (CET(High)), carbon taxes (CT), green subsidies (GS)), and firms' adaptive investment behavior. The main findings are as follows: First, CBAM only in EU is predicted to have non-significant health-economic impact on Chinese socio-economic systems. However, a worldwide CBAM could have a significant negative impact on Chinese economy: the financial stability of firms, house-holds, banks and the government has been shaken. Second, compared with current CET market (Baseline), the CET (High) policy does not provide significant health benefits, while lead to a 0.1% lower total GDP.

CT policy has health synergies due to abatement effects, resulting in a 0.28% reduction in labor productivity damage, while GSUB has economic benefits, resulting in a 0.15% increase in total GDP. Third, when only firms make additional adaptation investments, there are significant health-mitigation synergies and reduced shocks to the firms themselves. However, this approach increases instability of households, banks and government sectors. Portfolio policies should be good choices.

53: Simulating Social Network Impacts on Meat-Eating Pat-terns: An Agent-Based Approach
Xitong Dai, Jiaqi Ge, Andrew Prestwich and Tony Craig

Diet significantly influences individual and public health outcomes and impacts land and resource use, making it crucial for sustainability. As the global population grows, understanding dietary choices is essential for promoting healthier and more sustainable consumption patterns. Social networks profoundly affect people's diets, either reinforcing habits or encouraging changes. This study employs an agent-based model (ABM) informed by survey data to explore meat-eating behaviors. The survey captures data on participants' meat-eating behaviors, demographics, and social networks, including the nature and influence of their top ten contacts. Using the Theory of Planned Behaviour (TPB), the survey measures attitudes, subjective norms, and perceived behavioral control regarding meat consumption. The collected data will be regressed to create a utility function predicting meat-eating behaviors. The ABM simulates agents' decisions based on demographic attributes and social influences. By integrating empirical survey data, the model replicates real-world dynamics, examining how various factors affect meat consumption. The study aims to provide insights into meat consumption behaviors to inform public policy, health interventions, and educational campaigns promoting sustainable and healthy dietary practices.

54: Assessing and Improving Literature Review Practices for Agent-Based Models: A Meta-Review
Sebastian Achter, Melania Borit and Matthias Meyer

Agent-based models (ABMs) are recognized for their ability to simulate interactions among diverse agents within spatial environments, addressing both individual and collective behaviors, and facilitate the exploration of phenomena from micro to macro scales. This capability extends across various disciplines, including environmental science, engineering, or public health. Despite their popularity, the field faces challenges such as redundancy and lack of cumulative progress due to isolated studies. In response, literature reviews offer a solution by synthesizing ABM-based research from modeling practice to model findings. However, previous research

revealed a scarcity of systematically conducted ABM reviews in ecology and social science, with only a small fraction adhering to rigorous standards. This current study extends this analysis to a broader range of disciplines, advocating for a systematic approach to literature reviews that enhances transparency and reproducibility. By doing so, it aims to provide researchers with a powerful tool to foster cumulative scientific progress that is critical for the sustained growth of the agent-based modeling community.

55: Modeling decision-making of Dutch farmers to understand lock-ins in the transition to a sustainable food system

Natalie Davis, Niko Wojtynia, George van Voorn, Mark Koetse and Brian Dermody

To address the interconnected environmental, social, and economic challenges facing the Dutch food system, production practices must change, but many farmers feel locked into their current unsustainable methods of food production. Here, we present a model of farmer decision-making regarding land use and production methods, and discuss how it will be used to explore scenarios to alleviate these lock-ins. The main agents in the model are farmers, who choose a land use, production method, and market; interact with each other through a social network to exchange knowledge and share environmental concern; and apply for funding from bank agents. Also represented exogenously are markets and suppliers, via prices, and the government, via scenarios representing changes to subsidies and regulation. The model was designed using the Three Spheres of Transformation framework and concepts from multi-criteria decision-making, and incorporates qualitative and quantitative data from interviews, surveys, and the annual farm census. Scenarios of future model runs, reflecting interventions aimed at each of the Three Spheres (personal, political, and practical) and combinations thereof, are also described.

56: The Effect of Homophily on Co-Offending Outcomes

Ruslan Klymentiev, Luis E C Rocha and Christophe Vandeviver

Co-offending is the act of committing a crime in a group. While it involves some risks, criminals engage in co-offending to achieve specific goals and needs, such as receiving physical assistance during the crime or learning new skills to commit more sophisticated crimes. The interactions between co-offenders can be represented by social networks and one of the mechanisms of criminal network formation is linked to homophily, which is the tendency of individuals with similar characteristics to connect with each other. Offenders who commit crimes together tend to be similar in terms of age, sex, and race. However, it is still not clear how partner selection and homophily affect co-offending outcomes. The aim of this study is to explore how similarity-based partner selection affects the structure of criminal networks and, consequently, the co-offending outcomes. To achieve this, we have developed an Agent-Based Model that

simulates a population of offenders. By manipulating the level of homophily in the environment, we are able to track the differences in the number of connections in the network, the strength of these connections, along with the total number of co-offenses, and the average number of skills acquired.

57: The Role of Network Rewiring in Influencing Extremism and Pluralistic Ignorance
Ezgi Topuz and Gönenç Yücel

Opinion dynamics research employs statistical physics and network science to understand how opinions spread and evolve. Rewiring, where individuals change their social connections, plays a crucial role in this process. We explore the effects of zealots and probabilistic rewiring, discovering that societies generally moderate over time as agents adjust their connections. With the presence of zealots, despite social pressure, agents often choose isolation over adopting minority opinions, leading to cohesive groups of extremists that can influence society. Rewiring helps reduce pluralistic ignorance and hidden extremism by allowing agents to modify their social networks and resist extreme views.

58: Inverse Generative Social Science for Identifying Stochastic Agent-Based Models
Gayani Senanayake and Minh Kieu

This research proposes Adaptive Genetic Programming (AGP) for stochastic Inverse Generative Social Science (IGSS) to effectively evolve Agent-Based Models (ABMs) of pedestrian movement and navigation behaviours. It aims to address the limitations of existing approaches that rely on predefined rules and modeller assumptions while optimising computational efficiency and solution quality. It provides a more datadriven and systematic way to develop stochastic pedestrian ABMs. The methodology involves specifying basic behavioural rule primitives and permissible ways of combining them, choosing a fitness metric to compute model-target alignment, and using an evolutionary algorithm to search the space of rule combinations. The case study focuses on generating stochastic exit selection behaviour from bottom-up given a target dataset. The results demonstrate the effectiveness of the approach in discovering accurate and interpretable models that capture the underlying stochastic processes.

60: Generating Spatial Synthetic Populations Using Wasserstein Generative Adversarial Network: A Case Study with EU-SILC Data for Helsinki and Thessaloniki
Vanja Falck

Using agent-based social simulations can enhance our understanding of urban planning, public health, and economic forecasting. Realistic synthetic populations with numerous attributes

strengthen these simulations. The Wasserstein Generative Adversarial Network, trained on census data like EU-SILC, can create robust synthetic populations. These methods, aided by external statistics or EU-SILC weights, generate spatial synthetic populations for agent-based models. The increased access to high-quality micro-data has sparked interest in synthetic populations, which preserve demographic profiles and analytical strength while ensuring privacy and preventing discrimination. This study uses national data from Finland and Greece for Helsinki and Thessaloniki to explore balanced spatial synthetic population generation. Results show challenges related to balancing data with or without aggregated statistics for the target population and the general under-representation of fringe profiles by deep generative methods. The latter can lead to discrimination in agent-based simulations.

61: Consumer Types and E-Retailing Market Concentration: An Agent-Based Approach
Teng Li

The phenomenon of high concentration in China's e-retail markets is not yet fully understood. This study aims to explore its potential origins from the perspective of consumers. To fully elucidate the impact of consumer type on market structure, sellers are assumed to be homogeneous, while consumers are segregated into four types based on two dimensions. An agent-based simulation model was developed to examine the changing trends of market concentration ratios under diverse conditions. The simulation findings suggest that the concentration ratio of the e-retailing market is significantly influenced by the type of consumer. If conservative consumers who provide positive feedback to products dominate, the market tends to rapidly concentrate and eventually become a monopoly or oligopoly. However, it does not concentrate when risk-taking consumers who provide negative feedback prevail. This research supports pre-existing market structure theories and is relevant for e-retailing market practitioners and administrators.

62: Theorizing (co-) evolution of agent-based modelling and simulation for studying community energy systems: the case of collective energy security modelling
Javanshir Fouladvand

Agent-based modelling and simulation (ABMS) is becoming one of the prominent computational modelling approaches for studying community energy systems (CESs) as key elements for the local energy transition. For the first time, this study theorizes the (co-) evolution of CESs and ABMS as a research approach to study them. In addition to the five elements of the coevolutionary framework (i.e., technology, formal institutions, user practices, business strategies and ecosystem), the study also included modelling purposes for its analysis to delve into the details of ABMS. The insights delineate three missing modelling purposes, namely

illustration, analogy and social learning. Technologies and user practices are the most evolved elements, while formal institutions and ecosystems are the least evolved elements. Specific business strategies focusing on the CES members' economic gains are studied in detail. To demonstrate and make its approach concrete, the evolution of ABMS studying collective energy security is analyzed as an example, which highlights the evolution of technologies, formal institutions, and modelling purposes. Further insights and future research avenues are elaborated on in detail.

63: How Interdisciplinary Are Agent Based Models in General and Those of Human Decision in Particular? A Bibliometric Analysis

Loïs Vanhée and Melania Borit

Agent-based models (ABMs) have been described as integrative boundary objects for interdisciplinary research, as being rooted both in modelling human deliberation and in the interdisciplinary cases in which they are applied. This bibliometric study explores the interdisciplinarity of publications on ABMs in general and of those connecting ABMs with human deliberation in particular (via cognition & emotion) in the last 50 years. Results show an overwhelming presence of Computational sciences all along the scientific chain, from the citations used in both types of documents, where these documents are published, and what type of literature cites these documents, albeit slightly less markedly when ABMs feature cognition & emotion. Despite dominating the research field, documents from Computational sciences achieve the lowest scores regarding interdisciplinarity measures and are among the least cited per document, when compared to other disciplines.

65: Towards a Formalism for the Social Identity Approach

Fjalar de Haan

A formalism is presented for the social identity approach — a family of successful social-psychological theories explaining inter- and intra-group dynamics. The proposition of this paper is that a formalism may contribute to the further sophistication of social simulation modelling by distilling the logical essence of the social identity approach and presenting it in a form that can readily be implemented in software. Moreover, several key explanations the social identity approach offers simply follow. The paper sets up the formalism and uses it to explain the emergence of group identity and the phenomenon of group polarisation. These explanations will be presented as formal derivations. The results are compared with the theoretical and experimental work on the social identity approach.

67: A Generic Modelling Framework for Last-Mile Delivery Systems
Önder Gürcan, Timo Szczepanska, Vanja Falck, Patrycja Antosz, Merve Seher Cebeci, Michiel de Bok, Rodrigo Tapia and Lóránt Tavasszy

Large-scale digital twinning projects are complex, and their objectives are manifold. Consider for instance a digital twinning platform that will demonstrate efficient, replicable and socially acceptable innovative last-mile delivery solutions. One of the objectives can be to assess how consumers choose a delivery method, including how decisions evolve in the social environment of consumers. However, no single modelling and simulation tool can realize such objectives. In contrast, there are simulators for modelling consumer behaviour, and there are simulators for modelling freight transport. Based on this observation, in this study, we claim that to tackle such complexity a high-level architecture should be defined, and we present the blueprint of a dedicated generic modelling framework. We define the dedicated generic modules, the necessary input and output data, and the interconnections between the modules. During this process, we address issues related to the suitability of input/output data and the risk of creating incompatibility. We provide two real-world case studies to show the proposed modelling framework's effectiveness.

69: Evaluation of Infection Prevention Measures in Elementary Schools using an Agent-Based Model
Shuta Kikuchi, Taisei Mukai, Keisuke Nakajima, Yasuki Kato, Takeshi Takizawa, Junichi Sugiyama, Yasushi Kakizawa and Setsuya Kurahashi

Elementary schools are places where infectious diseases can spread extensively, and governments worldwide have proposed infection prevention measures for schools during the COVID-19 pandemic. In this study, a simulation model was constructed to assess the effectiveness of micro-level individual measures against contact transmission. Based on the actual students' communication and contact behaviors, we virtually replicated the movements of students using an agent-based model (ABM). As a result, it was discovered that respiratory hygiene and cough etiquette are effective in mitigating contact transmission. Moreover, immediate handwashing after virus contact was shown to be effective in preventing the spread of viruses by avoiding contact with doors. Wiping hands with a handkerchief or conducting hand disinfection was found to be most effective when carried out immediately on-site.

70: Mapping sustainable development goals using Agent-Based Models
Indushree Banerjee and Maurits Ertsen

Sustainable Development Goals (SDGs) 9 and 15 address pressing global challenges related to disaster preparedness and biodiversity conservation. Goal 9, which focuses on building resilient infrastructure and fostering innovation, is crucial for enhancing society's capacity to mitigate and respond to disasters effectively. Similarly, Goal 15, centred on conserving and sustainably managing terrestrial ecosystems, is paramount for safeguarding biodiversity and ecosystem services essential for human well-being. This extended abstract presents findings from two agent-based modeling (ABM) studies addressing these SDGs. The ABMs demonstrate the transformative potential of using simulations to investigate the impact and consequences of new technologies and policies on human values in complex environments. Our simulations focus on a socio-technical system for disaster communication and a spatially explicit socioecological system to investigate the interconnectedness of rivers, tigers, and human populations under climatic variations. The results highlight the importance of inclusive strategies and integrated management approaches for achieving SDGs 9 and 15.

71: Simulating reality- challenges of modelling human-wildlife coexistence using ABM
Indushree Banerjee and Maurits Ertsen

Agent-based modeling (ABM) has emerged as a powerful tool for simulating complex socio-ecological systems, particularly in the context of sustainable resource management and policy formulation. This extended abstract explores the challenges of modelling human-wildlife coexistence in Bardia National Park, Nepal, using a spatially explicit ABM. The study investigates changes in water availability and their impact on human-wildlife coexistence, hypothesizing that tigers may move their territories into human settlements when lacking access to water. By integrating diverse empirical datasets, including elevation data, tiger and prey spatial data, and surface water data, the model aims to capture the complex interactions between tigers, prey, and human settlements. The insights gained from this case study can inform future research. They contribute to the development of more accurate and reliable ABMs for sustainable resource management and policy formulation in complex socio-ecological systems. This research highlights the importance of considering the complex interactions between ecological factors and human activities in conservation efforts aimed at promoting sustainable human-wildlife coexistence.

72: The THEMP approach in agent-based modelling: when theory and empirics meet
Nanda Wijermans, Eva Vriens and Giulia Andrighetto

This conference contribution details a nuanced approach that integrates THEoretical and EMPirical elements in the development and testing of agent-based social simulations (THEMP). Although discussions often dichotomise between empirical and theoretical approaches, we argue that many social simulation modellers inherently combine both methods without a shared language to articulate this synergy. We will detail our approach that embraces both theory and empirics and stimulates the attention and sharing of all aspects to describe our models.

73: Democracy in Crisis: Using Social Simulation to Explore Policies for Countering Radicalization
Nikitas Marinos Sgouros

It is widely acknowledged that the rise of radicalization poses major challenges to democratic and open societies as it casts doubt on the legitimacy of decision-making processes, creates polarization that threatens tolerance and consensus building and can motivate the use of violence to promote its ideals. To counter such threats we seek to develop a policy incubation testbed for facilitating the exploration of counter-radicalization policies through the use of agent-based social simulation. To this end, we simulate and comparatively evaluate policy models that combine restriction measures with efforts to increase socialization in the population. Our models are able to deal with various agent networks with different features and dynamics that operate in parallel on the same population.

74: Modelling for Policy Without Policy Modelling
Alexander Melchior and Frank Dignum

This paper reflects on the efforts of the ABM community to model for policy from our perspective as policy developer. Our goal is to enrich the understanding the community of this perspective on the policy processes and draw attention to more opportunities for modelling in the policy process. We make this explicit by introducing the problem cycle as part of the policy process. The problem cycle can be understood as an iterative process that precedes the policy cycle and has its own goals and results. By modelling in the problem cycle modellers can add valuable contributions to the policy process without modelling a policy. We provide two initial tools to modellers to advance their thinking on how to do this. One: a mapping showing the usefulness of the various model(ling) goals for each policy phase. Two: a classification of different types of governments and what they value. We conclude by stressing that it is always

important to have conversations with policy people on equal footing to identify how to usefully model for policy without modelling a policy.

75: Real time Parameter Changes in Agent-Based Models with Mesa
Rajith Vidanaarachchi, Branislava Godic, Leon Booth, Victoria Farrar, Simone Pettigrew and Jason Thompson

Agent-Based Models (ABMs) have become popular in studying complex systems and supporting decision-making in policy modelling. This paper introduces an advancement in the field of ABMs by implementing a feature for real-time parameter changes within the Mesa modelling platform's web visualisation module. We aimed to create a feature that would allow users to interact directly with a model and its parameters and observe immediate changes to the results while simulations are running. We detail the technical modifications made to Mesa's visualisation architecture that enable this functionality, which is facilitated by establishing bidirectional communication between the model and the visualisation server. The resulting enhanced visualisation architecture within Mesa now allows stakeholders to modify parameters on the fly, providing immediate feedback and enabling a deeper understanding of complex dynamics as they unfold. This capability is demonstrated through several prototypical models, including the Schelling Segregation model and the El Farol Bar problem. These prototype models highlight the practical implications and advantages of this development for real-time policy simulation and decision support where rapid responses are crucial. This paper asserts that the novel developments that allow the integration of real-time parameter changes into ABMs can be utilised to improve their effectiveness and applicability in various disciplinary contexts.

76: An agent-based simulation of Online Rumor Diffusion Incorporating Individual Attitudes and Opinion Leaders
Lingyue Li, Yike Luo and Hang Xiong

Attitudes are regarded as a key driver of human behavior, and yet their role in online rumor diffusion is largely unexplored. In this study, we empirically study the extent to which attitudes contribute to the diffusion of emergent online rumors. We analyze the diffusion of a social medical rumor where over 1500 individuals taking participation through Weibo. For each agent, the embedded attitudes were measured based on eight so-called basic emotions from Plutchik's wheel of emotions (i.e., anticipation–surprise, anger–fear, trust–disgust, joy–sadness). We then separated emotions into negative, positive, or neutral attitudes, and estimated using a modified model how attitudes are associated with the spread of emergent online rumors. Our results suggest that transitions conveying negative attitudes spread over longer time horizons, and become more viral. We further study how the presence of find that rumors cascades with high

degrees of vitality and a low foundation of trust between net friends who are larger in size, longer-lived, and more viral. Altogether, attitudes embedded in emergent online rumors and the power of opinion leaders are important determinants of the spreading dynamics.

77: Strongly Empirical Modelling
Bruce Edmonds, Dino Carpentras and Edmund Chattoe-Brown

The paper argues for, and discusses, the practice of "Strong Empirical Mod-elling". This involves a shift in effort from the internals of a model towards how the model relates to observational data. This kind of modelling is con-trasted to theory-based modelling which, it is argued, will not be sufficient for making substantive progress understanding social phenomena in a sci-entific manner, due to the inherent weakness of social theory. However, there are different ways of relating data to modelling, so these are reviewed and criteria for their strength and the difficulties discussed. A sketch of how to define the empirical strength of a model is discussed, and the piece ends with a suggested system of "Modelling Ready Levels" to eliminate confusion about the state of modelling projects.

78: Simulating farmers' adoption of technologies based on cognition: the case of a smart farming technology
Yawen Yu and Hang Xiong

The use of smart farming technologies is widely viewed as a key to addressing environmental and resource challenges in agriculture. However, due to barriers influenced by economic, psychological and social factors, farmers' adoption remains low in China. To address this complexity, the Unified Theory of Acceptance and Use of Technology provides a theoretical framework by integrating three factors to form farmers' cognition, intention and behavior. Agent-based model serves as a powerful tool to simulate these dynamics, enabling a detailed exploration of how individual decisions combine to influence sustainable agriculture. The paper aims to present an ABM of farmers' decision-making of adopting smart farming technology. The results indicate that the different interactions on water-saving effect of subsidy, training and water tariff interventions.

79: Bringing worlds together: When public health and social simulation approaches collide
Branislava Godic, Ivana Stankov, Rajith Vidanaarachchi and Jason Thompson

This abstract focuses on the experiences of social science researchers while working with researchers in public health and describes the challenges faced in bringing these two disciplines together. These reflections will aim to capture the experience of interdisciplinary research

between the two fields, highlighting differences in expectations and understandings of research aims and methodologies, the presence of 'agendas', the role of the modeler in the research, and the effect of differing understandings of the meaning of 'data' (e.g., empirically collected versus simulated data) on project progress and outcomes. The aim of this paper is to summarise and share these experiences with the modelling and social simulation community for the benefit of interdisciplinary future research practice.

80: Is Your Model Estimable? Bias and Identifiability in the Bounded Confidence Model
Claudio Borile, Valentina Ghidini, Corrado Monti and Gianmarco De Francisci Morales

Agent-based models (ABM) show how global patterns emerge from simple individual behaviors. Opinion dynamics models, such as the bounded confidence model (BCM), describe how a population can reach consensus, fragmentation, or polarization, depending on a few parameters. Connecting such models to real-world data has the potential to verify or falsify model assumptions, and to better understand such phenomena. A key aspect is the estimation of the model's parameters: maximum likelihood estimation provides a principled way to estimate its parameters. Here, our goal is to outline the properties of statistical estimators of the two key BCM parameters: the confidence interval and the convergence rate. We find that their estimators present different characteristics: while the maximum-likelihood estimator of the confidence interval is always identifiable and unbiased, the estimator of the convergence rate shows a persistent bias. Moreover, their joint estimation is affected by identifiability issues for specific regions of the parameter space: several local maxima are present in the likelihood function. Our results show how the analysis of the likelihood function is a fruitful approach to improve our understanding of the pitfalls and possibilities of estimation of ABM parameters.

81: Case Study on Calibration Methods for a High-Dimensional Global Trade Agent-Based
Kejian Li, Jiaqi Ge, Lomax Nik and Gary Polhill

This study conducts a case study on calibration methods for a high-dimensional global trade agent-based model. We compare the efficacy of Latin Hypercube Sampling (LHS), Genetic Algorithms (GA), and approximate Bayesian Computation (ABC) in calibrating this complex model. LHS explores the parameter space comprehensively, GA optimizes effectively, and ABC combines exploration with statistical inference. Our findings show the strengths and weaknesses of each method, highlighting the need to choose calibration methods suited to the model's dimensionality and complexity. This study offers useful insights for researchers and practitioners working with high-dimensional agent-based models.

82: Towards empirical representative ABM: Analyzing social influence in the context of climate change adaptation

Thorid Wagenblast, Tatiana Filatova, Amineh Ghorbani and Martijn Warnier

Social interactions are frequently modeled in agent-based simulations. Often, they rely on predefined structures and interaction patterns. In the context of climate change adaptation, social influence plays an important role. Using cross-national survey data, we aim to identify patterns of social interaction in this context to refine how we model this currently. We describe two groups, communicators and non-communicators, and how the insights from the data analysis in these groups can be used to update social interaction based on personal characteristics and risk perception in an agent-based model.

83: Reading Between the Boxes: Finding Tipping Points in Human-Earth Systems Using Scenario Discovery

Gabriel Sher, Alessandro Taberna, Tatiana Filatova and Jan H. Kwakkel

In response to the increasing risk of coastal flooding due to climate change, this study adapts scenario discovery to identify tipping points in the a flood-exposed coastal economy. We use the Climate-economy Regional Agent-Based (CRAB) model, which simulates household and firm adaptation behaviors in a flood-prone region. We use behaviour-based scenario discovery to explore the range of dynamics possible in the model's population variable (including delayed growth, leveling off, and collapse-recovery patterns) and find the conditions under which they occur. We then look at the boundaries be-tween these condition regions to attempt to define critical tipping points be-tween system states. Our findings show that minor changes in economic parameters, especially one controlling firm pricing, can lead to abrupt shifts in population dynamics. The method is promising for model exploration but needs some improvements to be useful in policy-making applications.

85: Digital Twins for Decision Support: An example of Regional Transforming Steel Industries

Anna Kravets, Veronika Kurchyna, Jan Ole Berndt and Ingo J. Timm

Decision-makers in transformation processes face complexities introduced by evolving regulatory landscapes and market dynamics. This study delves into the use of Agent-Based Models (ABMs), Multi-Agent Systems (MAS), and Digital Twins (DTs) to support strategic planning through the simulation of intricate interactions and dynamics. Our research specifically focuses on the application of MAS and DTs to the steel industry's shift from coal-based to hydrogen-based processes, with a strong emphasis on sustainability. By analyzing literature, case

studies, and theoretical frameworks, we provide insights for modelers on leveraging these technologies for industrial transformation. We present a conceptual framework designed to address complex decision-making challenges and propose a corresponding architecture. We identify potential benefits of ABMs, MAS, DT in steel industry transformation and illustrate how these tools can become particularly valuable for understanding market dynamics, enhancing stakeholder engagement, and incorporating non-monetary factors into decision-making.

87: Modeling Racial/Ethnic Disparities in Diet: An Agent-Based Approach to Understanding Diet Dynamics in Philadelphia
Andres Useche, Ivana Stankov and Brent Langellier

Racial/ethnic disparities in diet and obesity are remarkably consistent across cities and have persisted or gotten worse over time. Disparities in obesity prevalence mirror observed disparities in dietary patterns, highlighting the critical role of diet as a behavioral determinant of weight status. This study examines how racial/ethnic residential segregation, the uneven distribution of food outlets, the affordability of energy-dense, non-nutritious foods, and income inequality intersect to produce disparities in diet in Philadelphia, US, using an agent-based simulation model (ABM). We find that diets vary among different racial groups and the concentration of households in segregated neighborhoods favors the adoption of less healthy diets vs. less segregated neighborhoods. The findings of this study aim to foster interdisciplinary dialogue on addressing the complex issue of obesity. Our model represents an innovative integration of food access and housing factors to analyze their collective influence on disparities among demographic groups

88: Realistic gossip in a Trust Game on networks
Jan Majewski and Francesca Giardini

Gossip has been shown to be a relatively efficient solution to problems of cooperation in reputa-tion-based systems of exchange. At the same time, many studies don't conceptualize gossiping in a realistic way, often assuming near-perfect information or broadcast-like dynamics of its spread. To solve this problem, we developed an agent-based model that pairs realistic gossip processes with different variants of Trust Game. The results show that cooperation declines when local interactions govern spread of gossip, because cooperators cannot discriminate against defectors. Realistic gossiping increases the overall amount of resources, but is more likely to promote defec-tion. Moreover, even partner selection through dynamic networks can lead to high payoff inequal-ities among agent types. Testing mutations of different strategies shows that cooperation evolves when agents copy the most successful of their peers and declines sharply without strong adaptive pressures.

92: An analysis of spatial and temporal uncertainty propagation in Agent Based Models

Yahya Gamal, Alison Heppenstall, William Strachan, Ricardo Colasanti and Kashif Zia

Spatially explicit Agent Based Models (ABMs) are used to simulate and explore temporal urban dynamics. Visualising the spatial uncertainties in such ABMs is crucial to communicate the reliability and the validity of the models. This must be applied while considering empirical distributions of inputs associated with social behaviours. The spatial uncertainty analyses should also consider temporal uncertainties at both the initial and final ABM state. However, the current uncertainty frameworks either (1) consider spatial uncertainty at the end of model simulations only (e.g., Sensitivity and Uncertainty Analysis (S-UA) approach) or (2) consider non-spatial uncertainties at different model states. To address this, we propose a Spatio-Temporal Uncertainty-Quantification (ST-UQ) approach that spatially visualises the temporal propagation of uncertainty from an initial to a final model state. The approach uses elements from the S-UA framework while maintaining the empirical distribution boundaries of inputs. It generates a set of propagation indices for comparing uncertainties in a model output at two different time steps. We show preliminary results for an application on a smoking behaviour ABM (Tobacco Town calibrated to California, USA) to show the impact of smoking rates on output spatial uncertainties.

93: Agent-Based Social Simulation for Professional Training: What to Know?

David Anzola

This text centres on the use of computational models for professional education. Even though, training is fundamental for the consolidation of professional domains, the literature on agent-based social simulation does not extensively discuss how computer simulation can be used for the training of new entrants. Potential alternatives, the text suggests, should be assesses against criteria organised in two major categories: those pertaining to the context of teaching and learning and those pertaining to the context of modelling. Overall, the discussion shows, there are no univocal 'best decisions' when it comes to the implementation of simulation-based education. Ultimately, from a teaching and learning point of view, teachers should make sure that simulation-based education is constructively aligned. Complementarily, from a modelling point of view, potential advantages and disadvantages should be evaluated against the backdrop of a variety of individual and collective goals and constraints, as well as particular beliefs, assumptions, and preferences that affect the everyday professional practice of agent-based social simulation.

94: Attitude change through economic narratives
Michael Roos and Matthias Reccius

We propose a model, in which agents have an attitude on a political issue or a proposed policy. This attitude is the result of their mental model, which specifies the perceived causal structure of the relevant economic and political system, and their values, that determine whether the expected outcomes of a policy are desirable for the agent or not. The privately formed attitude responds to narratives told by other agents. A narrative is defined here as a story about a publicly discussed policy that contains both a prediction of the policy's outcome and the desirability of that outcome.

95: Fostering the Linkage Between Agent-based Modeling and Ontologies: A Research Agenda
Rocco Paolillo, Carmelo Fabio Longo, Antonio Zinilli, Misael Mongiovì, Lorenzo Giammei, Andrea Giovanni Nuzzolese and Mario Paolucci

We outline a research agenda for the integration of agent-based modeling with semantic ontologies. While the literature on the topic seems quite limited, the interaction between the two models can be valuable on different layers, leveraging the synthesis and formalization of structural knowledge, together with the interoperability of data. The integration of the models can span over the steps of modeling conceptualization and calibration, together with new knowledge from simulation scenarios. As an empirical niche of application, we build on data on academic mobility and co-authorship collaborations. A major focus is on the embedding of knowledge formalization into the cognitive architecture and decisional processes of agents. To this aim, we build mainly on the belief-desires-intention (BDI) protocol as a scaffolding for mapping semantic ontologies derived from empirical models and theories. We present a conceptual example of our research goal in the context of academic mobility and rational choice.

96: A behavioural agent-based model for housing markets: impact of a financial shock on wealth in the UK
Yahya Gamal, Corinna Elsenbroich, Nigel Gilbert, Alison Heppenstall and Kashif Zia

Mortgage based housing markets are interconnected with the financial systems. The mortgages in these markets are tied to the interest rates applied on borrowing in the financial markets. This is the case in the UK where mortgage interest rates are agreed over a fixed period (between 2 and 5 years) based on the Bank of England's. These restrictions affects the behaviours of home buyers, tenants and investors in the housing market, particularly in cases of financial shocks such as the 2022 UK interest rate shock. Collective changes in behaviours create dynamics that can

affect prices, rents and households' wealth. To understand such dynamics, we introduce a behavioural Agent Based Model (ABM) representing the interactions between home buyers, tenants and investors in a housing market. We use the model to showcase the effects of an interest rate shock on the behaviours of the market actors, and in turn on households' wealth. The ABM indicates that such shock affects less wealthy households more significantly.

97: Morality to Boost Social Identity Modeling?
Marlene Batzke

Morality is a concept that has rarely been addressed in social simulation. Yet, it concerns a fundamental aspect of how humans understand the world, applying categories such as "right" and "wrong" that are relevant for human decision-making, cognitive dynamics, and group processes. The present work aims at making a step towards conceptualizing morality based on psycholog-ical theory, namely moral foundation theory, and applying it within the larg-er theoretical framework of social identity theory. It is illustrated how social identity modeling may be enriched by integrating moral foundations, provid-ing a theoretical basis for representing an individual's morality-based group evaluation and group identification processes, and thus modeling dynamics in individuals' social identities. A conceptual example is presented of how moral foundations may be integrated into social identity modeling in the context of political opinion dynamics. Social identity theory represents a suitable starting point for taking a step towards formalizing human morality that may also provide opportunities beyond social identity modeling.

99: Using Agent-Based Simulations to Study Organizational (Re)production of Inequalities: Training Investments and Retirement
Konrad Turek, Shaoni Wang, Wander Jager, Kees Zoethout, Patrycja Antosz and Kene Henkens

Computational simulations, such as Agent-Based Modelling (ABM), offer novel ways to study organisational dynamics and employment relations from a complex-system perspective. This approach allows insights into bottom-up and mutual relationships, such as those between employees, employers and the organisational environment. This study aims to connect older workers with their organisations to analyse how different organisational settings (e.g., training policies), employer approaches, and social norms (e.g., retirement norms) affect work and retirement outcomes at older ages. Drawing upon a multi-level organisational theory, employer decision-making theories, and organizational inequality paradigm, we consider mechanisms behind beneficial and harmful workplace practices and their indirect impact on macro-level patterns and inequalities. Specifically, we focus on human capital investment strategies (e.g., inclusive and exclusive) and their consequences for older workers' retirement behaviours. We

hypothesise that exclusive approaches (e.g., supporting only talented workers) can lock specific groups in disadvantaged career paths, counteracting ageing policies and contributing to inequality in the ability to work longer. For this, we designed an ABM simulation model calibrated with empirical data from large-scale surveys of employers and older workers from the Netherlands.

100: Preliminary findings from a systematic literature review for agent-based social simulation with respect to high-performance computing use
Doug Salt, Alison Heppenstall, Ricardo Colasanti, Richard Milton, Matt Hare, Michael Batty and Gary Polhill

We have been conducting a systematic literature review on the potential and actual use of high-performance computing facilities in agent-based social simulation. As part of this exercise we report here some lessons from the initial bibliometric analysis and screening exercise for that review. One of the principal issues we had was identifying from titles and abstracts of articles whether the work reported met our criterion for a model being `agent-based' -- a computer simulation involving explicit representations of the dynamic interactions of heterogeneous individuals. This is in part a challenge derived from the multiple application domains to which agent-based modelling is applied, but also because of the lack of agreed qualifying criteria for a model to be called `agent-based'. We also reflect on the different domains in which empirical agent-based social simulation is applied, as, together with the ability to find agent-based models in the literature, this is critical to being able to find and catalogue successful use-cases of the application of agent-based social simulation to scenario analysis and decision-making

101: Behavioral Realism in Integrated Assessment Models: Insights from the TransportTransform Agent-Based Model
Luja von Köckritz, Merlin Radbruch, Oreane Edelenbosch, Els Weinans, Detlef van Vuuren and Maja Schlüter

This study aims to enhance the representation of human decision-making in Integrated Assessment Models (IAMs) by incorporating insights from behavioural science in an agent-based model (ABM). The TransportTransform ABM captures the complexity and variability of real-world consumer decisions by going beyond modelling rational choice. The ABM incorporates behavioral factors like habitual behavior, social influence and infrastructure constraints in shaping transportation choices. By evolving IAMs from rational choice to more complex decision processes, the model aims to improve realism and widen modelled policies. Challenging the idea that consumer demand solely shapes supply, the study emphasizes the importance of the exogenous physical context in user deci-sions, drawing on affordance theory

and social sciences. The agent-based TransportTransform model analyzes interactions at individual, meso, and system levels, linking personal mobility choices with network decision-making mechanisms. It provides insights into how mode occupancy, habitual decision-making and social norms influence system patterns of user behaviour. Uniquely, the model combines internal aspects such as attitude formation with external aspects such as social norms or experiences with transportation modes. The model confirms the importance of affordances in modal choice, showing that habitual behavior significantly impacts transport mode selection, with cars being the most popular, followed by biking and public transport. Overall, this study underscores the importance of social dimensions in sustainability within IAMs and offers a valuable framework and implemented model for analyzing user behavior.

103: Agent-based and microsimulation modelling for tax-benefit policy analysis: Implications for policymaking
Jesse Lastunen, Jia An Liu and Serge Stinckwich

Taxation and public spending are key policy levers available for governments to influence the distribution of income, determined both by market forces and institutions, and the distribution of wealth and property. Microsimulation and agent-based model- ling, two distinct methods of individual-based social simulation, have both been applied to evaluate the distributional effects of fiscal policies and to facilitate policy planning and development in this area. In this presentation, we will compare the two methods in the context of tax-benefit policy analysis and planning.

105: Price Dynamics and Market Competition in Resort Industry: An Agent-Based Modelling Approach
Emiliano Alvarez, Juan Gabriel Brida, Pablo Cardenas and Luis Moreno-Izquierdo

When resorts' quality is not directly observable before consumption, destinations have various signaling tools to capture customers, among others: the number of customers, the type of customers and pricing strategies. Taking into consideration companies that seek to increase their profits and customers with budget restrictions and with both individual and social preferences, this work analyzes price dynamics and conditions of market competition, under an Agent-Based Modelling (ABM) setting. An emerging result of this process is the formation of resorts with greater market power and high customer differentiation, although less than in the case without budget restrictions. At the same time, adjustment speed of the companies have non-linear effects on prices, the benefits of the resorts and individuals' utility. Another emerging result is that price dynamics is highly sensitive to the information that both resorts and individuals have.

107: The Agent-based Model of Online Protest and Repression in Authoritarian Settings
Aytalina Kulichkina, Annie Waldherr and Nanda Wijermans

Social media can amplify protest movements in authoritarian settings but also enable repression by regimes and their supporters. Empirical research on online protest and repression has established the need for exploring mechanisms affecting their dynamics, which can be addressed using an agent-based modeling approach. Our study draws on this research and relevant formal and agent-based models to simulate social media interactions between protesters and repressors, which can result in either enduring campaigns or silence of suppressed voices. Our central aim is to understand what key mechanisms affect these dynamics and how. To this end, we present a conceptual agent-based model that takes into account the most relevant social media features and the central drivers for online protest and repression specific to authoritarian settings. We address the following pressing questions: What combinations of factors allow protests to scale up and dominate over repression for the longest on social media? Conversely, which combinations of factors assist repression in scaling up and weakening protests fastest on social media? Ultimately, the model will help us understand how dissenting voices are empowered and suppressed in authoritarian contexts online. The findings of this study can contribute to the theoretical understanding of digital activism in authoritarian settings and the development of strategies for policymakers, activists, and social media stakeholders to navigate, counter, and prevent digital repression.

108: Towards Dynamic Population Synthesis Through the Use of Machine Learning
Iohan Sardinha, Mariam Afonso, Jadna Cruz, Rosaldo Rossetti and Ana Paula Rocha

Synthetic populations are instrumental in analyzing natural populations, with agent-based microsimulations being their most prevalent application. These simulations serve various fields, including transit planning, epidemiology, and urban development. Traditionally, population synthesis methods have been plagued by the generation of overly similar populations and high computational demands. Recent advancements in machine learning offer promising alternatives, enabling the creation of diverse agents that maintain statistical significance while considerably reducing computation time, specially for populations with numerous attributes. A notable advancement in this domain is the integration of temporal dynamics into population synthesis, leading to the concept of Dynamic Synthetic Population. Despite the longstanding exploration of demographic update methods, their seamless integration with population synthesis remains a challenging and open question. The incorporation of machine learning techniques holds the potential for addressing this gap. This research proposes a novel methodology for developing a Dynamic Synthetic Population Framework specifically tailored to the Metropolitan Area of Porto. The proposed framework uses machine learning to generate temporally dynamic synthetic

populations with reliable activity chains. This dynamic synthesis approach facilitates comprehensive analyses of population changes. It supports the exploration of various future and past scenarios, thereby enhancing the utility and accuracy of microsimulations in diverse fields.

109: Modelling Misinformation Spread: The Role of Network Density in Diverse Social Structures
Soroush Karimi, Marcos Oliveira and Diogo Pacheco

Understanding the relationship between network features and misinformation propagation is crucial for mitigating the spread of false information. This study examines how network density affects the dissemination of hoax news using an SIR (Susceptible-Infectious-Recovered) framework. Our findings show that increased network density leads to more believers in misinformation, with the number of believers rising higher among more gullible individuals. In segregated networks, denser clusters have a higher proportion of believers, regardless of group gullibility parity. As an important result, a dense minority can significantly amplify belief percentages within majority groups, highlighting the substantial impact of minority structure on majority dynamics.

110: Combining Vignette Surveys with Agent-Based Modeling: Insights on Fraud Dynamics with Empirically Calibrated Norm Sensitivities
Alexandra Eckert, Matthias Meyer and Christian Stindt

Fraud is a widespread problem in many organizations, resulting in substantial economic losses and other detrimental outcomes. Given that individual and social factors influence the prevalence and dynamics of fraud, agent-based modeling (ABM) has been introduced as a promising method to investigate the empirically difficult-to-capture phenomenon of fraud. However, providing an empirically sound model of fraud dynamics remains challenging. This paper strives to con-tribute to this aim. We first conduct a vignette survey informed by Bicchieri's definition of social norms, assessing individual norm sensitivities across two scenarios. Then, we use the survey data to calibrate agents' decision-making in our agent-based fraud dynamics model. We find that only slight differences in norm sensitivity distributions obtained from the two vignettes result in substan-tially different fraud dynamics: While fraud is contained in one scenario, it spreads and dominates the organization in the other. Overall, our study demon-strates how vignette studies and agent-based modeling can be combined to strengthen the empirical basis of models of human behavior.

111: Uncertainty Quantification for Agent Based Models: A Tutorial
Louise Kimpton, Peter Challenor and James Salter

We explore the application of uncertainty quantification methods to agent-based models (ABMs) using a simple sheep and wolf predator-prey model. This work serves as a tutorial on how techniques like emulation can be powerful tools in this context. We also highlight the importance of advanced statistical methods in effectively utilising computationally expensive ABMs. Specifically, we implement stochastic Gaussian processes, Gaussian process classification, sequential design, and history matching to address uncertainties in model input parameters and outputs. Our results show that these methods significantly enhance the robustness, accuracy, and predictive power of ABMs.

113: No Numbers: Qualitative Structural Validation of Explanatory Social Agent-Based Models
Mijke van den Hurk, Mark Dechesne and Frank Dignum

Quantitative data seems to be essential when validating social agent-based models. However, data collection can be challenging for explanatory social agent-based simulations due to the inherent complexity of underlying social processes. Despite repeated mentions of validating such ABM's qualitatively, we observed an absence of explicit approaches. In this paper, we propose the use of qualitative structural validation, combining several validity methods. We will demonstrate its application on our own ABM about identity fusion and argue how a qualitative approach can create explainable stories, contributing to exploration and explanation of social phenomena.

114: Toward Automating Agent-based Model Generation: A Benchmark for Model Extraction using Question-Answering Techniques
Siamak Khatami and Christopher Frantz

Agent-based modeling is a simulation method that is attractive to simulationists and non-simulationists (e.g., domain experts without simulation backgrounds) to collaboratively engage in agent-based modeling. This involves documenting narratives, creating conceptual and simulation models, and applying and evaluating the model's output. However, this can be a challenging task, especially for non-simulationists. In the literature, various methods have been proposed to bridge the gap between narrative text and simulation model development, such as using standards like ODD for better document structuring, UMLs for illustration, and natural language modeling for direct text-to-code conversion. The objective of this work is to look at the opportunities rendered by Question-Answer models to support the extraction of model

information from narratives, e.g., to render an understanding of the simulation model described in formal or informal terms, serving as a starting point to draw on such techniques to foster collaborative modeling based on diverse data sources, but also to generate executable models. Emphasizing the initial objective, in this paper, we propose a benchmark and roadmap for extracting model information from text applicable to a range of models and applicable across diverse simulation models. This benchmark includes the specification of general ABM features to be extracted, as well as the selection of simulation model samples, showcasing variability in feature set and formality. Our findings indicate that among a set of 13 open-source and 3 commercial models, to date only commercial models provide tangible achievements. Specifically, OpenAI's recently released ChatGPT-4O model offers the strongest performance across our sample (average precision rate: 84%) compared to other models such as ChatGPT-4.5-turbo (57%) and ChatGPT-3.5 (40%). We discuss opportunities and implications for the use of QA models for information extraction purposes and future developments, as well as the need for pre-training and fine-tuning open-source models to be meaningfully engaged in this effort.

115: Bridging two worlds: understanding macroeconomic effects of private climate change adaptation by integrating agent-based models with computable general equilibrium models

Liz Verbeek, Tatiana Filatova, Theodoros Chatzivasileiadis, Alessandro Taberna and Ignasi Cortes Arbues

Decision support for climate change policy is dominated by the use of Computable General Equilibrium (CGE) models. These macro level economic models are often critized for underestimating damages and ignoring distributional effects. Meanwhile, this "top-down" macroeconomic approach is increasingly helped by micro level tools like agent-based models (ABM). ABMs are valuable tools in representing realistic and adaptive behavior, heterogeneity of actors, social interactions and out-of-equilibrium dynamics. However, since they are designed to operate on the micro level, they are not very well suited to scale up to national scales or further, which limits their usefulness for climate policy. In the past, various efforts have been undertaken to bridge these two modelling worlds by linking macro and micro approaches. In our current research, we explore the possibilities for linking CGE and ABM models to bring the strengths of both methods together. In this presentation, we will discuss our experience with the model integration process, present the results of the first integrated model runs, and would like to elicit feedback on the alignment of assumptions between these two alien approaches.

116: Towards Realism for Policy Testing
Maarten Jensen, Loïs Vanhée and Frank Dignum

Essential in a social simulation model that has the purpose of "understanding the effectiveness of a policy on society", is that the agents can not only follow the policy, but also have ways of breaking the policy. Especially modelling the motivations for breaking a policy requires additional aspects of life in the simulation. However, adding all these aspects can have a toll on the scalability of the model. This paper is dedicated to explaining why these aspects together are relevant to the realism of modelling for policy testing. The paper ends with an illustration that state-of-the-art pandemic simulations achieve some but not all requirements. And concludes as a way forward to consider both conceptual and engineering improvements.

117: Towards understanding collective resource use: the role of individual attribution of ecological change
Nanda Wijermans, Caroline Schill, Therese Lindahl and Maja Schlüter

Common pool resources, like fish, timber, water, are essential in providing food, income and raw material. However, maintaining sustainable practices for common pool resources is a collective challenge due to the social and ecological uncertainties. Climate impacts only further complicates the collective governance of these resources, as resource availability will substantially change and reduce. To understand how do resource users actually deal with these changes in resource availability is a central to our understanding the sustainable collective use of natural resources. From the few empirical studies available we learned that fishers make differently sense of ecological change, which should be taken into account when studying how collective resource use behaviour changes in dynamic social (what others may do) and ecological settings. Yet, very few studies of collective sustainable resource use, if any, investigate the role of heterogeneous attribution of ecological change mechanisms at the individual level for collective resource use. Our project thus seeks understanding of the role of how individual's attribution of ecological change may influence sustainable collective resource use with agent-based modelling (ABM).

118: Predicting governance failures in community-based enterprises through a transdisciplinary Agent-Based Modelling instrument
Arthur Feinberg, Amineh Ghorbani and Tine de Moor

In this study we propose a user-friendly tool which enables community-based enterprises to self-assess their internal set of rules and identify the possibly related collective action challenges, in a resilience perspective. We therefore build a piece of software which links an Agent-Based

Model (ABM) to an existing dataset of CBEs where inputs are retrieved, and which is executable via a web-based interface. The simulations launched in one click on the interface later generate a user report. The ABM is based on two previously published models.

119: From Surveys to Simulations: Conceptualizing the Design of an Agent Decision-Making Architecture for Renewable Energy Technologies
Stephanie Stumpf, Daniel Sloot and Wolf Fichtner

The transition to a decarbonized energy system necessitates not only techno-logical advancements but also widespread consumer adoption of renewable energy technologies. Photovoltaic (PV) systems, for instance, rely on intri-cate household decision-making influenced by economic, socio-demographic, psychological, and social factors. To address this complexity, theory-based approaches from diverse disciplines and individual-level data are essential for understanding the mechanisms driving renewable energy adoption. Agent-based modeling (ABM) provides a powerful tool to simulate these dynamics, allowing nuanced exploration of how individual decisions aggregate to produce adoption patterns. This paper attempts to establish a household decision-making formalization of an ABM for the diffusion of re-newable energy technologies using the example of PV adoption. With our proposed agent decision-making mechanism, we emphasize the importance of theoretical foundations as well as empirical evidence for modeling house-hold behavior.

120: An agent-based exploration of maladaptation
Yvonne Lont and Jan Kwakkel

Organizations and networks are confronted with an escalating uncertain environment, necessitating adaptive strategies to ensure sustained effectiveness. Adaptation and adaptive behaviour are traditionally assumed to manage these changes effectively. However, emerging empirical evidence in the socio-ecological literature shows that actions aimed at adaptation can be ineffective or even have adverse consequences. This is also known as maladaptation. While considerable research has investigated adaptation in socio-technical systems, when adaptive actions intended to improve performance, actually lead to deteriorated outcomes remain poorly understood. We use an agent-based discrete-event model to examine adaptive behaviour mechanisms and their effects on performance over time. Extending Epstein's adaptation model, our maladaptation model entails how coordination structures impact agent decisions on adapting to changes and vice versa, with agents endogenously creating and modifying these structures. With this model, we aim to theoretically investigate when and how maladaptation emerges, contributing to an understanding of this phenomenon.

122: Ethical Dimensions to Empirical Applications of Agent-Based Social Simulation
Gary Polhill, Melania Borit, Corinna Elsenbroich, Harko Verhagen and Nanda Wijermans

This paper builds on the contribution of Anzola, Barbrook-Johnson and Gilbert (2022; ``The ethics of agent-based social simulation'' Journal of Artificial Societies and Social Simulation 25 (4), 1) with a view to furthering the community's discussion of ethical principles associated with our endeavours. We give particular attention to empirical applications of agent-based social simulation.

123: Different Bottom-Up Simulation Methods and Policy Applications: A Perspective
Kavin Preethi Narasimhan

This paper presents a perspective on the use of bottom-up simulation methods like microsimulation, agent-based modelling, discrete event simulation, and activity-based modelling for public policy. The paper draws on the literature on modelling methodology, model examples, policy guidance, and policy evidence from around the world to present an assessment of the current role of bottom-up simulation methods for public policy applications. The focus then shifts to emerging efforts to integrate Large Language Models (LLMs) with micro-level modelling and argues for other uses of LLM integration to improve the accessibility and visibility of bottom-up simulation methods. The objectives of the paper include the clarification of terminology and concepts associated with different bottom-up simulation approaches on the one hand and policymaking on the other, addressing the lack of access to knowledge about the distinction between different bottom-up simulation approaches particularly in the context of public policy, and stimulating discussion within and beyond the modelling community for good modelling practices.

124: The selfish social identity: Exploring dynamics of health behaviour, disturbance, resilience, and vulnerability through association
Jason Thompson, Catherine Haslam, Alex Haslam, Nik Steffens, Tegan Cruwys and Tarli Young

Background: The objective of this paper was to provide a representation of social identity's influence on the health of an abstract, modelled population. We aimed to demonstrate how each of the 15 hypotheses presented in Haslam (2018) may be modeled and tested in silico. Method: We constructed an ABM based on a preferential attachment backbone that identified groups and placed them in an abstract, 2-dimensional space of health and social status. We created functions in attempts to represent the dynamics hypothesised in Haslam et al (2018) and qualitatively assessed our efforts. Results: Of the 15 hypotheses modeled, we considered 9 to be well represented, 4 to be partially represented and 2 to be poorly represented where excessive

intervention by the modeler was required. Discussion: We have shown that a simple agent-based model based on network and graph theory can generate select phenomena in a dynamic environment as predicted by Social Identity Theory. We have also shown that the generation of other predicted phenomena require somewhat artificial intervention by the modeler to come about. This may highlight limitations of the model, skill of the modelers, or suggest weaknesses in the independence of tested hypotheses.

125: An agent-based framework for modelling linked decisions
Sascha Holzhauer and Friedrich Krebs

For a successful energy transition, small-scale private investments are required. The according decision are linked and governed by interaction, dynamics, bounded rationality, and actor heterogeneity. Agent-based simulation can contribute substantial insight, but a flexible yet well-founded modelling concept for this kind of linked decision-making is still missing. Therefore, we propose a probability-based, iterative approach for multi-investment decisions within a flexible framework. The principal idea is to iteratively select an investment decision with a previously defined probability, gather options, make the decision, and update remaining resources for further investments. The process is repeated until a feasible set of investment decisions is achieved.

126: Different Facets for Different Experts: A Framework for Streamlining The Integration of Qualitative Insights into ABM Development
Vivek Nallur, Pedram Aghaei and Graham Finlay

A key problem in agent-based simulation is that integrating qualitative insights from multiple discipline experts is extremely hard. In most simulations, agent capabilities and corresponding behaviour needs to be programmed into the agent. We report on the architecture of a tool that disconnects the programmed functions of the agent, from the acquisition of capability and displayed behaviour. This allows multiple dierent domain experts to represent qualitative insights, without the need for code to be changed. It also allows a continuous integration (or even change) of qualitative behaviour processes, as more insights are gained. The consequent behaviour observed in the model is both, more faithful to the expert's insight as well as able to be contrasted against other models representing other insights.

127: A conceptual modeling framework for coordination in multi-team incident response
Cezara-Maria Pastrav and Sofia Karlsson

Multi-team emergency response is, unfortunately, plagued by well-documented difficulties with coordination. Despite this being an actively studied problem, it persists, and it is much worse in the case of complex incidents. Agent based models have the potential to shed some light on the factors contributing to this problem, as well as on possible strategies to address it. However, such models are often simplified to the point where they are not fit for such purpose. We propose a conceptual agent architecture capable of complex decision making, using internal motivators (such as goals, norms, values), routines, and context-based reasoning. We aim to use simulating emergency services coordination during interventions in complex environments.

129: Assessing Effectiveness of Anti-Money Laundering System with Agent-Based Model
Łukasz Kraiński

The paper introduces Agent-Based Model (ABM) of Anti-Money Laundering (AML) system. The model replicates rule-based AML system, including details of transactions of financial institution's customers, specification of AML systems rules, heterogeneous structure of internal customers and external parties. Latent behaviour of individuals involved in money laundering is represented with utility-based agent capable of adjusting transaction patterns to maximize throughput of illegal transfers passing through the financial institution's accounts. We present results of two experiments to demonstrate use cases for the model in the context of operational excellence of AML system deployed within financial institution. First simulation experiment shows changing behaviour of laundering individuals in a response to increased investigation capacity. Second experiment reveals zonal decrease in quality of AML system due to emergence of new financial market.

131: Revealing visions of the future of exascale agent-based social simulation using participatory systems modelling
Matt Hare, Doug Salt, Ric Colasanti, Richard Milton, Michael Batty, Alison Heppenstall and Gary Polhill

This paper presents transdisciplinary research being conducted to identify visions of how future exascale computing resources could be exploited by Agent-Based Social Simulation (ABSS) scientists. Properly exploiting future exascale computing resources will likely require a major transition in practices and lead to an evolution in social simulation modelling. We report on two workshops involving participatory systems modelling with members of the social simulation community to explore their visions of potential exascale ABSS capabilities, use cases, capacity

requirements and threats. The two co-constructed causal loop models resulting from the workshops suggest new use cases including: a tool for individual-based social science as a new disciplinary branch; the identification of the best formalizations for qualitative social theories; very rapid or real-time support for decision making; meta-modelling; and general simulation emulator development. The model also identified unintended threats that might arise from exascale ABSS, including: increased energy consumption and costs; inefficient use of the exascale resources; the encouragement of spuriously over-complicated models; over-dependence on AI; over-zealous exascale computing gatekeepers; and inequitable access to exascale computing. Participatory systems modelling also revealed a number of ethical issues related to exascale ABSS as well as a negative feedback loop that might limit its development.

132: On the liquidity of the illiquid (hard-to-trade) assets
Marcin Czupryna and Paweł Oleksy

We examine the effects of agents' trading decisions on the liquidity observed on the markets for illiquid (hard-to-trade) assets. Employing an agent-based framework, we apply popular liquidity measures to assess their adequacy in reflecting market liquidity and transactional efficiency. The latter is measured by the percentage of all interested buyers successfully concluding trades. Our main findings reveal that conventional liquidity measures, such as the number of bids, asks, new bids, and new asks may not accurately represent overall transactional efficiency. Instead, volume -- measured by the number of trades, and relative spread measures may be more appropriate indicators of liquidity within the context of illiquid markets. Furthermore, our simulations demonstrate that the higher number of traders that participate in the market correlates with an increased efficiency in trade execution, while wider trader-set margins may decrease the transactional efficiency. Interestingly, the trading period of the agents appears to have a significant impact on trade execution. This suggests that granting market participants additional time for trading (for example, through the support of automated trading systems) can enhance transactional efficiency within illiquid markets.

133: Invasion of the mind snatchers: the use of generative AI agents in agent-based social simulation
Harko Verhagen, Nanda Wijermans, Bruce Edmonds and Wenyue Hua

Generative AI is all over the place, mainly in the form of large language models (LLMs). Recently, LLM researchers moved into the world of replacing human participants in social and behavioural science research and even social simulation. In this paper we want to make our community aware of these developments, discuss our worries but also the potential for using

LLMs productively with agent-based social simulation, and pose some questions to the LLM approach to social simulation.

134: Past, present, and future of agent-based social simulation modelling - presidential views
Harko Verhagen, Scott Moss, Nigel Gilbert, Mario Paolucci, Giulia Andrighetto, Wander Jager, Andreas Ernst, Flaminio Squazzoni, Gary Polhill and Petra Ahrweiler

During the Social Simulation Conference 2023 in Glasgow a discussion in one of the general sessions brought the idea to have an informal description of the past, present, and future of agent-based social simulation. Who better to offer such a paper than the collection of ESSA presidents so far? It forms the core of the ESSA organizational memory is you wish, and given the variety in backgrounds, experiences, and interests among them, there is something for everyone, reflecting the multitude of positions in the ESSA and SSC community.

135: Towards synthetic city modeling for synthetic populations
Przemyslaw Szufel and Adam Kasiński

The process of building agent-based models (ABM) often requires the construction of a synthetic population. The synthetic population is subsequently placed in some environment where agents interact with each other as well as with the environment. In urban simulations, the environment is a city where agents are moving around (e.g. commuting), interacting with each other or the environment --- businesses, public services, or amenities. In order to run this type of simulation, synthetic populations are being constructed that have sociodemographic properties (income, age, household structure) similar to the real-world population. However, in order to run an ABM simulation, a model of an environment --- a synthetic city, also needs to be constructed. In this paper, we propose initial guidelines for a method for generating a synthetic city that can be used as an environment for ABM simulations. Similarly, to a synthetic population, a synthetic city should have structures resembling the real-world in terms of the availability and density of points-of-interest (POIs) including public transportation, locations of businesses, and the availability of services such as education or healthcare.