Supplementary Material

Combining social network analysis and agent-based modelling to explore dynamics of human interaction: A review

Supplementary Material A: Selection criteria for review articles

We conducted a Web of Science Topic Search (TS) using the search term TS = ("agent based model*" OR "agent based simulation" OR "multi-agent model*" OR "multi-agent simulation") AND "social network*". We restricted our search to publications published until the end of 2018 in English which yielded 518 results. We are aware that especially in the area of network research there are other terminologies (e.g. network model or game-theoretic model) that refer to similar concepts and do not fall under our search restrictions. However, we believe that agent-based modelling is a reasonable umbrella term for all these approaches and that most results are transferable.

Due to the broad range of agent-based models coupled with social networks we did not aim to provide a systematic comparison of all publications in the field. We narrowed the focus to two main aspects: awareness and recentness. We thus pre-selected the most-cited publications (publications with 30 or more citations (66), 4 January 2019) and the newest articles (those published in 2018 (70)). Of course, this selection is not intended to be exhaustive but it provides an overview of the diverse ways of integrating and evaluating social networks in agent-based models.

From this redefined data set, we selected 54 publications to be included in the review (23 with 30 or more citations and 31 published in 2018) in the following way: We excluded articles if the methods used did not fit with the focus of our examination. This was the case if no agent-based model was presented in the paper, or if no social network was explicitly integrated in the model, or if the agent-based model has not been used to study social networks or the network did not play a significant role in the model description or evaluation. Additionally, we excluded models without an explicit connection between the agents (covering e.g. location based networks where the agents move around and visit the same spaces but do not directly link to each other) and models relying only on lattice networks or fully connected graphs as these structures limit the range of methods for evaluation that we suggest as being advantageous for agent-based models with integrated social networks. We furthermore focused on social networks where the connections are set up between human beings and thus removed articles targeting at ecology and animal related questions. As we concentrate on applications of agent-based models, we also did not include reviews.

Supplementary Material B: Classification of the reviewed models

The following table provides the classification of the reviewed agent-based models. It is structured according to the three main areas of application: Epidemiology/public health (6 publications), marketing (25 publications) and social dynamics (23 publications). The description of the studies includes a summary of the research interest and key findings as well as a characterization of the main aspects concerning agent behaviour and network properties. In particular, this covers information on the decision making of the agents, the interaction topology (exogenously imposed, endogenously emerging or co-evolutionary), the relevance of the network to the model (network effect) and aspects considered in the analysis of the model (agent-centric, network-centric or structurally explicit for exogenous or co-evolutionary networks and evaluation quantity for endogenous network formation). Furthermore, models where the purpose of the network is social integration are marked (in section research focus); all other models deal with diffusion processes. We do not provide information on network properties such as link reciprocity and link weight as this information is not clearly stated in all reviewed studies.

Epidemiology/Public Health

Reference	Research focus	Agent decision-making	Interaction topology	Network effect	Model analysis	Key findings
Davey, Glass, Min, Beyeler, & Glass (2008)	Examine interventions and strategy combinations for pandemic influenza mitigation.	The spread of influenza in a person-to-person transmission event should be reduced by network- and case-based interventions. Agents cannot actively make decisions.	Exogenous network: Groups of given sizes within which individuals of specified ages (kids, teens, adults, seniors) interact and average number of individuals with which a person has contact within the group is specified; basis for fully connected, random or ring networks for each group; contact network exhibits "small-world" character and multiply-overlapping quality of structured community; demographics of the population within this model conform to the 2000 U.S. Census Detail	Person-to-person transmission event within contact network; simulation instigated with 10 adults chosen at random	Agent-centric: Effect of network-based (school closure, child and teen social distancing, adult and senior social distancing) and case-based (quarantine, antiviral treatment, household antiviral prophylaxis, extended contact prophylaxis) interventions on percentage of population infected, average adult days at home and population antiviral coverage.	Best strategy combines network-based and case-based interventions and is robust to a wide range of uncertainty.
Fetta, Harper, Knight, & Williams (2018)	Explore the effect of individual friendship selection decisions and the impact they may have on the overall evolution of a social network. Compare the resulting network with	Agents decide whether to form links based on six different approaches: random, Adamic/Adar, Katz, Stochastic Actor Based, PageRank and a newly developed algorithm PageRank-Max (based on the	Endogenous network formation	Agents iterate through the links changes offered by the selected link prediction method finding their maximum	Evaluation quantity: Precision of network formation algorithms to replicate existing school network data	The proposed PageRank-Max methods is the most successful in predicting the evolution of adolescent friendships, in terms of both precision and network structure.

	existing data from a smoking cessation program in secondary schools.	optimisation of an individuals' eigencentrality).		personal objective function.		
F. Fu, Rosenbloom, Wang, & Nowak (2011)	Explore the roles of individual imitation behaviour and population structure in vaccination.	Agents decide whether to change their vaccination uptake strategy depending on their own current payoff and that of one randomly chosen other agent.	Exogenous networks: Lattice (von Neumann), random, scale-free	Spread of disease (SIR Model) and vaccination behaviour (probability for adoption given by Fermi function)	Agent-centric/Network-centric: Effect of population structure (structured vs. well-mixed case) on vaccination level and final epidemic size parameter variation: cost of vaccination, sensitivity to observed payoffs	Vaccination uptake depends on agent's sensitivity to observed payoffs and costs. As agents become more adept at imitating successful strategies, the equilibrium level of vaccination falls below the rational individual optimum. In structured populations, vaccination is widespread over a range of low vaccination costs, but coverage plummets after cost exceeds a critical threshold.
Hornbeck et al. (2012)	Determine the impact of hand hygiene noncompliance among peripatetic healthcare works compared with less-connected workers.	Agents are assigned a level of hand hygiene noncompliance which influences the spread of pathogens.	Exogenous network: Empirical data recording contacts among healthcare workers and patients	Infection is passed with fixed probability in case of contact between infected and uninfected individual, additional infection by environment possible	Agent-centric: Parameter variation: probability of transmission, hand hygiene baseline compliance, hand hygiene efficacy, environmental contamination transmission rate Scenarios: impact of hand hygiene compliance based on connectedness of healthcare workers	The average number of infected patients is higher when the most connected healthcare worker not practice hand hygiene and lower when the least connected healthcare workers are noncompliant.
Moradianzadeh, Zadeh, Kobti, Hansen, & Pfaff (2018)	Optimize the palliative care system where agents search the networks to find a proper team of care provider agents to fulfil their missing	Patients need help to fulfil their goal and send requests to care providers which can also spread this request to other care providers in their own network. Patients choose the team with minimal operational and geographical distance costs.	Co-evolutionary network: Initial network structure generated by an algorithm that is following the power-law	Care provider linked to patients in the network offer their help to support them in achieving their goals.	Agent-centric: Comparison of synthetic networks with various distributions of patients and care providers against simulations with Brute Force model (patients can	The proposed approach is capable of finding the proper team of care providers with the highest satisfaction rates in a shorter time (compared to other models taken into account).

	capabilities with the lowest overall cost.		distribution; links are added between care provider and patient if care provider forwards request to its network and patient makes use of the offer it is not linked to so far		search among all care providers) and random selection model (patient request is sent to a set of care provider agents which are chosen randomly)	
Perlroth et al. (2010)	Evaluate health outcomes, costs and cost-effectiveness of antiviral and social distancing strategies (combinations of adult social distancing, child social distancing, school closure, household quarantine, antiviral treatment and antiviral household prophylaxis) during an influenza pandemic.	The spread of influenza in a person-to-person transmission event should be reduced by network- and case-based interventions. Agents cannot actively make decisions.	Exogenous network: Same network structure as in Davey et al. (2008)	Same transmission as in Davey et al. (2008)	Agent-centric: Effect of mitigation strategies on health outcomes and costs and cost-effectiveness Parameter variation: infectivity, case fatality rate, level of population compliance and antiviral effectiveness	Preferred mitigation response to a pandemic depends on its severity. Influenza pandemic with moderate severity, the most cost-effective strategy involves a combination of adult and child social distancing, school closure and antiviral treatment and prophylaxis, if available. For mild pandemics, a multi-layered strategy of adult and child social distancing and antiviral treatment and prophylaxis is effective and cost-effective but that the addition of school closure is relatively expensive.

Marketing

Reference	Research focus	Agent decision-making	Interaction topology	Network effect	Model analysis	Key findings
Amini, Wakolbinger, Racer, & Nejad (2012)	Compare the impact of three supply chain production-sales policies and negative word-of-mouth on the supply restricted diffusion process of a new generic product and the net product value of profit generated by this product.	The probability that agents adopt a new product depends on positive word-of-mouth, advertising, and/or negative word-of-mouth.	Exogenous network: Random	Adoption of new product with probabilities based on number of satisfied/dissatisfied adopters, rejecters and lost consumers	Agent-centric: Performance characteristics of three production-sales policies based on the net present value of profit generated over the diffusion process	Build-up policy with delayed marketing is the preferred policy. It is critical to consider the impact of negative word-of-mouth in choosing production-sales policies.
Baggio & Hillis (2018)	Examine the simultaneous diffusion of ecological disturbances and	Each social agent is able to exclusively manage one patch. Agents are able to	Exogenous networks: Ecological: Spatial	When agents employ social learning, they are either	Agent-centric/Network-centric:	Managers who imitate other successful managers and have access to accurate information

	management strategies across a multiplex, social-ecological network. Address the relationship between learning, social-ecological structural properties and the adoption of treatment strategies that counter ecological disturbances.	adopt a treatment at a specific cost. Agents make their adoption based on their payoff, the type of learning they employ (individual or social), the feedback from the ecological path they are managing, and the information they acquire from their social network. Feedbacks between the social and ecological systems occur in form of general utility that a social agent receives from the ecological path they are managing.	Social: Spatial (matching ecological network), random, small-world with rewiring probability 0.2 and 0.3, scale-free with low or high preferential attachment	conformists (adopt strategy adopted by the majority of their social neighbours) or success-biased imitators (adopt strategy of the individual neighbour that is doing best).	Effect of learning types and network structural properties on the expected disturbance	are most effective at controlling disturbances. The structural properties of the social-ecological network also play an important role: An increase in inter-layer assortativity and average multiplex degree reduce the expected disturbance prevalence, while an increase in local clustering increases it.
Beretta, Fontana, Guerzoni, & Jordan (2018)	Investigate the effect of cultural dissimilarity of the adopters and their degree of assortativity on technology diffusion using the example of the diffusion of fertilizers in five Ethiopian villages.	Households decide to adopt the technology if their randomly chosen level of adoption exceeds a threshold. The threshold depends on their cultural group status and the number of neighbours and adopters per group.	Exogenous networks: Small-world (low and high clustering), scale-free (low and high clustering)	Threshold value depends on the cumulative group-wise counts of neighbours who have adopted (minority, majority), the number of neighbours per group and an assortativity factor.	Network-centric/Structurally explicit: Effect of network type, seeding strategy and assortativity levels for majority and minority on technology adoption Comparison of model results with observed data from Ethiopian villages	Diffusion evolves the fastest in small-world settings. Scenarios with first adopters in a marginal network position and, in general, the scale-free network with low clustering displays a slower pace of adoption. For the scale-free network with high clustering, betweenness and eigenvector seeding differ only marginally and display almost congruent shapes for the other network structures. To minimize the differences between the observed and simulated data, similar social network structures but a different position of the first adopter in the network and different levels off the average assortativity are suggested.
Bohlmann, Calantone,	Examine the effects of various network structures (network	Agents decide on adoption based on the behaviour of	Exogenous networks:	Agents decide on adoption based on	Agent-centric/Network-centric:	Network structure can impact diffusion in terms of peak

& Zhao (2010)	topology and the strength of communication links between innovator and follower market segments) and relational heterogeneity on innovation diffusion within market networks.	their neighbours (probabilistic threshold).	Lattice, random, small-world with rewiring probability 0,1 and 0,2, scale-free	the behaviour of their neighbours (probabilistic threshold); link weight implicitly included in two-segment model where agents weigh interaction in their own segment more heavily than those in the other segment	Parameter variation: Level of adoption threshold, segment sizes Comparison of network structures	adoption and the likelihood of saturated diffusion. Individual locations within a network and communication influences for new product diffusion are important.
Chareunsy (2018)	Simulate the diffusion of three development initiatives (encourage school attendance, introduce safe water handling practices, feeder road to facilitate engagement with markets) that differ in their approaches to reaching targeted groups in a southern Lao community.	The decision to adopt a change in behaviour is based on the relative influence of adopters and non-adopters within a household's network. Agent will choose to adopt a practice if the window of influence of adoption (determined by the weighted sum of agents across common network activities) is greater that the window of influence for non-adoption. At the beginning, an outsider recruits selected agents to change their behaviour.	Exogenous network: Connection to all agents with common activities	Agents' decision to adopt is based on relative influence of adoptees vs non-adoptees in the network.	Agent-centric: Comparison of the dynamics of the three development initiatives for a synthetic population of 58 agents equipped with properties from household survey data	The Water initiative is the most successful both for the community as a whole and in reaching the lowest tier of society. The Education initiative fails to transmit a behaviour change, such that ultimately even the educators (the chosen agents) give up. The Market initiative succeeds in reaching all community members but the gains accrue disproportionately to the well-off who are best positioned to absorb the initial impetus.
Chen, Taylor, & Wei (2012)	Examine the influence between network structure (size, degree, weight) and energy-saving behaviour.	Agents decide whether to increase or decrease their energy consumption based on the norm imposed by the energy use of their peers.	Exogenous networks: Random (varying number of nodes, degree and link weight)	Agents change their energy consumption behaviour based on the behaviour of their network neighbours.	Network-centric: Comparison of network structure	Network energy consumption does not decrease or increase with the expansion of the random network, if newly added vertices have a similar level of energy consumption. Connection degree and strength of the relationship between residents each has a

						positive impact on residents' energy saving.
Erdlenbruch & Bonte (2018)	Simulate the adoption of individual adaptation measures to floods and evaluate the efficiency of different communication policies in a model parameterized with data from a survey conducted in France.	The decision model of the agents is based on the psychological protection motivation theory (PMT) that decomposes the individual adaptation motivation into variables relating to threat appraisal and coping appraisal. A logistic regression of an individual's intention to implement non-permanent adaptation measures on the household's attributes is run.	Exogenous networks: Spatial, small-world (spatially explicit), random (varying degree)	The higher the proportion of neighbours in the household's network who have adapted, the higher its attribute level for the social network variable.	Agent-centric/Network-centric: Comparison of adaptation levels with and without network influence Comparison of network structures	Policies which contain information on both the risk of flooding and how to cope with it perform better than policies which only deal with risk. People centred policies on risk and coping perform the best in all scenarios. The absence of the small world network decreases the absolute value of adaptation levels. The network types and degrees have no impact on the simulation results.
Goldenberg, Libai, Moldovan, & Muller (2007)	Understand how the interplay between positive and negative information, as well as weak and strong ties, affects the growth of new products and the consequent economic results.	The probability that agents adopt a new product depends on positive word-of-mouth, advertising, and/or negative word-of-mouth.	Exogenous network with dynamic properties: "dynamic small-world" with strong-tie structure inside each social system being fixed and weak-tie structure randomly reassigned in each period	Spread of information on new product with probabilities based on number of satisfied/dissatisfied adopters and rejecters	Network-centric: Linear regression with dependent variable of Net Present Value to analyse the effects of dissatisfaction, strength of the weak ties, advertising and interaction effects (level of weak and strong ties)	The effect of negative word-of-mouth on the Net Present Value of the firm is substantial. Weak ties help to spread harmful information through networks and can become a negative force for the product's spread.
Haenlein & Libai (2013)	Compare the effectiveness of revenue leader seeding with opinion leader seeding and random seeding on the spread of a new product.	The probability that agents adopt a new product depends on positive word-of-mouth, advertising, and/or negative word-of-mouth.	Exogenous network: Algorithm reproducing link formation in actual social networks (relatively small average distance between pairs of	Adoption of new product with probabilities based on number of satisfied/dissatisfied adopters, rejecters and lost consumers	Network-centric/Structurally explicit: Parameter variation: network clustering coefficient, standard deviation of the customer lifetime value, customer	Both revenue leader seeding and opinion leader seeding can create greater value compared with random customer seeding. The distribution of customer lifetime value in the population and the seed size play a major role in determining which seeding approach is preferable.

			nodes, clustering coefficient larger than in random networks, approximately scale-free degree distribution)		lifetime value assortativity and seed size	
Heinrich (2018)	Apply a catastrophe theory model to the problem of network industries. Compare the equation-based implementation to an agent-based model with a simple decision heuristic for several network structures.	Every agent is either an adopter of the new technology or not. Agents decide whether or not to adopt based on their expected utility from using the better technology.	Exogenous networks: Fully connected, ring, scale-free, scale-free with triadic closure	The adoption of the new technology by current non-adopters and the disbandment of the newer technology by current adopters follow a probabilistic function which is a cubic function of the number of adopters in the agent's network.	Network-centric: Effect of number of initial adopters Comparison of network structures Comparison of equation-based and agent-based model	The general behaviour of the findings of the equation-based model is preserved in the agent-based model. The behaviour of the model changes locally depending on the network structure, especially if networks with features that resemble social networks (low diameter, high clustering, and power law distributed node degree) are considered.
Hu, Lin, Qian, & Sun (2018)	Examine promotional strategies for new product diffusion based on different target (influential, susceptibles, or unsusceptibles), size and intensity of the seeding incentive.	Consumers decide whether to adopt the product using a threshold model where each agent has a unique threshold to map the heterogeneity between the agents. If the peer effect, which is determined by the fraction of adopted peers in the local network of the consumer, exceeds this threshold, the consumer adopts.	Exogenous network: Small-world (spatially explicit in social space)	The proportion of adopted peers in the local network determines the peer effect which has to exceed the individual threshold of the consumer to induce adoption.	Agent-centric/Structurally explicit: Effect of target types (influential, susceptibles, unsusceptibles, and random), target sizes and promotion intensity on product diffusion	Where a budget is limited, the best approach is to target as many susceptibles as possible with a weak promotion. Targeting unsusceptibles with free products should be the first choice, where the budget is large. In other cases, the best approach is to target as many influential as possible with a moderate promotion.
Huétink, Vooren, & Alkemade (2010)	Study the development of the market for hydrogen vehicles taking into account different strategies for hydrogen	Consumers: The decision of the consumers to adopt a hydrogen vehicle depends on their level of innovativeness, their	Exogenous networks: Fully connected, lattice (Moore), small-world	Consumers evaluate the fraction of adopters in their network and adopt the innovation if the	Network-centric: Effect of infrastructure strategies (station placement, size of initial fuel	Maximum geographical coverage with initial stations is more effective as a deployment strategy than focusing on densely populated areas. The structure of

	infrastructure development and user behaviour.	reservation price and on the perceived attributes of hydrogen vehicle technology determined by technological learning, social learning processes and fuel availability. Refuelling station: The refuelling station considers the percentage of consumers within its customer base that have adopted a hydrogen vehicle. When this percentage of adopters exceeds a threshold value, the station adds hydrogen to its product range.		adoption rate exceeds their personal threshold determined by the adopter group they are assigned to.	infrastructure) on number of adopters Parameter variation: Number of initial adopters Comparison of network structures	the social network among consumers does influence the resulting diffusion patterns; a small world social network is most favourable to fast diffusion.
Janssen & Jager (2001)	Explore the dynamics of markets where artificial consumers have to choose each period between similar products from a psychological perspective. Explore the consequences of changing preferences and the size of social networks.	Depending on uncertainty and satisfaction of social needs, agents apply different mechanisms to choose a product: repetition, deliberation, imitation or social comparison ("consumat" approach).	Exogenous networks: Small-world with rewiring probability 0, 0.01 and 0.1	For imitation and social comparison, agents evaluate the product which is consumed the most in its social network.	Agent-centric/Network-centric: Effect of minimum level of need satisfaction and uncertainty tolerance on market share of products Comparison of network topology and size	Behavioural rules that dominate the artificial consumer's decision making determine the resulting market dynamics. Psychological variables like social networks, preferences and the need for identity are important to explain the dynamics of markets. If social processes dominate a market, an increase in the size of the network causes the market to be dominated by a few products.
Janssen & Jager (2003)	Investigate the effects of different network structures on market dynamics.	Depending on uncertainty and satisfaction of social needs, agents apply different mechanisms to choose a product: repetition, deliberation, imitation or social	Exogenous networks: Small-world with rewiring probability 0, 0.1 and 1, scale-free, scale-free with 1% inactive links	For imitation and social comparison, agents evaluate the product which is consumed the most in its social network.	Agent-centric/Network-centric: Extension of Janssen & Jager (2001)	Market dynamics is a self-organized property depending on the interaction between the agents' decision-making process, the product characteristics, and the structure of interactions

		comparison ("consumat" approach).			Comparison of network topology and network parameters	between agents (size of network and hubs in a social network).
Kaufmann, Stagl, & Franks (2009)	Study the diffusion of organic practices through farming populations in Latvia and Estonia and evaluate the effectiveness of policies (effect of social influence, introduction of a higher subsidy, increased support by organic farm advisors) to promote them.	Based on Theory of Planned Behaviour, farm agents exchange opinions, update subjective norm estimates, and adopt organic farming practices if intention exceeds an empirically derived threshold.	Exogenous network: Small-world and scale-free properties (network parameter derived from survey)	Subjective norm as one factor characterizing intention towards adoption is influenced by one selected neighbour using the relative agreement model.	Agent-centric/Network-centric: Effects of social influence, introduction of a higher subsidy and of increased support by organic farm advisors on the diffusion of organic farming practices Parameter variation: Network density, preferential attachment and small-world property, type of agents on the hubs (not shown)	Social influence alone makes little difference; introduction of a subsidy is more influential. The combined adoption rate from social and economic influences is higher than the sum of the proportion of adopters resulting from just social influence and from just subsidies.
Libai, Muller, & Peres (2013)	Explore how acceleration and market expansion combine to generate value in a word-of-mouth seeding program for two competing products.	The probability that agents adopt one of the competing products depends on external and internal factors.	Exogenous networks: 12 empirical networks	Adoption of new product with probabilities based on number of consumers in network who have already adopted	Structurally explicit: Comparison of social value of word-of-mouth programs for different seeding strategies affected by competition, program targeting, profit decline, and retention	Market expansion dominates the social value of word-of-mouth programs. Relative to random programs, acceleration drives a greater proportion of influential programs' social value. The stronger a brand is relative to its competitor, the more acceleration drives its seeding program's social value, and the lower the program's social value is overall. The lower the future value of customers, the higher the acceleration ratio and the higher the relative social value of a program. A shorter horizon of analysis on the program's effect leads to a higher overestimation bias of the seeding program's

						social value. The higher the disadoption rate, the lower the acceleration ratio.
Moglia, Podkalicka, & McGregor (2018)	Describe the uptake of low carbon and energy efficient technologies and practices by households and under different interventions (non-financial and social network).	Households decide whether to buy a new product if the old product has reached the end of its life or the agent has been approached by a sales agent. The decision which product to buy depends on the level of needs satisfaction and uncertainty and results in repetition, imitation or optimisation or inquiry (based on the "consumat" approach).	Exogenous networks: Small-world, scale-free, spatial, random	For imitation agents copy the behaviour of a satisfied household in their social network.	Agent-centric/Network-centric: Comparison of interventions on adoption rates Comparison of network structures	Focus of the model on questions whether it is more effective to incentivise sales agents to promote energy efficient technologies, whether it is more effective to provide a subsidy directly to households, or whether it is better to work with plumbers so that they can promote these systems. Effect of social networks on adoption is only marginally discussed.
Negahban & Smith (2018)	Evaluate the optimal combination of seeding and inventory build-up policies for new products.	Consumers adopt or reject with probabilities depending on number of satisfied consumers or dissatisfied adopters, rejecters and lost customers that did not receive the product due to supply shortages, respectively.	Exogenous networks: Lattice (26 neighbours), random, small-world (based on lattice network), scale-free	Adoption of new product with probabilities based on number of satisfied and dissatisfied adopters, rejecters and lost customers (customers that did not receive the product due to supply shortages)	Agent-centric/Network-centric/Structurally explicit: Effect of seeding strategy (number of neighbours, number of nodes reachable within two steps, shortest average path length, lowest clustering coefficient, random), seeding fraction and build-up period (time before product is launched) on product adoption Comparison of network structures	The seeding strategy that maximizes the adoption rate is not necessarily optimal in the presence of supply constraints. Random seeding can maximize the expected net product value of profit for a scale-free network. However, random seeding increases the uncertainty in the diffusion dynamics.
Niamir, Filatova, Voinov, & Bressers (2018)	Track impacts of behavioural changes in individual energy use behaviour concerning (1) investments to save or produce energy, (2)	Based on Norm Activation Theory, households assess a four step procedure to pursue an economic decision: (1) If households	Exogenous network: Spatial	Households compare values of their own behavioural factors (awareness and motivation) with	Agent-centric: Effect of social learning in knowledge activation or in knowledge activation and	Exchange in knowledge about energy and climate leads to a significantly higher total count of the three types of household actions, while there is more

	conservation of energy by changing consumption patterns and habits, and (3) switching to another energy source.	feel guilty as their awareness (based on survey data) exceeds a threshold they (2) check their personal and subjective norms to calculate their motivation for each of the three actions. For those actions for which the motivation exceeds a threshold, the households feel responsible and go into (3) the consideration step where their perceived behavioural control is assessed to measure their intention. If a household has high intentions to undertake any of the three actions for making an energy decision, its expected utility based on its current energy sources and its budget constraints is calculated. To maximize their utility and make their energy decisions, households analyse their utility expectations and compare it with their current utility.		those of their 8 closest neighbours and adjust their value to become the mean of the 9 compared values.	motivation on the behavioural changes in individual energy use	intentions for investments that for the two other actions. Introducing additionally opinion dynamics regarding household motivation to act leads to a further increase in the diffusion of all three actions.
Pearce & Slade (2018)	Simulate the adoption of small-scale solar photovoltaic systems (PV) in Great Britain by considering decision-making of individual households based on household income, social network, total capital cost of the PV system, and the	Agents calculate the total utility of adoption and adapt if the utility exceeds a threshold. The total utility is made up of a weighted sum of partial utilities depending on household income, the social environment of the agent, economic attractiveness of the	Exogenous network: Random	Social utility of an agent depends on the number of adopters and agent is connected to and increases if an agent they are connected to adopts.	Network-centric: Effect of number of links to adopters on social utility (Social influence is not analysed in more detail)	Focus of the model is on the effect of feed- in tariffs. Effect of social networks on adoption is only marginally discussed.

	payback period of the investment.	investment, and the capital cost of the investment.				
Phan & Godes (2018)	Analyse the dynamics of the diffusion of several ideas for two types of individuals (independents with exogenous information and imitators) with endogenous link formation.	Independents are influenced with a fixed probability. Imitators adopt if the proportion of neighbours who have adopted exceeds a threshold. Between the diffusion of two ideas, agents may drop and add links while maintaining the same in-degree. Communication can be influenced by noise and time discounting.	Co-evolutionary network: Initially random; links deleted based on adoption status, new links formed randomly	Agents adopt if the proportion of neighbours who have adopted exceeds a threshold.	Agent-centric/Network-centric: Effect of penetration rate for variation in network density, probability that independents receive information, probability that independents listen to others in a period and probability that independent listen to other independents in a period for fixed network density on diffusion of ideas Scenarios with and without noise and with and without time discounting	In the baseline study (no noise, no time discounting) penetration is increasing with network density. Independents with good exogenous information have fewer followers than the average imitator. When independents listen to other agents, they gain more influence by producing access to better information. Less noise allows agents to be further away from the original source.
Rasoulkhani, Logasa, Reyes, & Mostafavi (2018)	Identify the effects of demographic and household characteristics, social network influence, and external factors such as water price and rebate policy on residential water conservation technology adoption.	Households are in one of the three states: non-adopter, potential adopter or adopter of the technology. The transition between non-adopter and potential adopter and between potential adopter and adopter is reached if the adoption utility and the affordability index exceed a utility and affordability threshold, respectively. If the utility threshold for the transition between non-adopter and potential adopter status is not reached, an agent can	Exogenous networks: Random, ring, small-world, scale-free	Given a user-defined likelihood of influence, if the non-adopter agent is connected to an adopter agent, there is a chance that the non-adopter will transition into the potential adopter state.	Agent-centric/Network-centric: Effect of water price and rebate scenarios on technology adoption Comparison of network structures	The adoption percentage fluctuates across all five social networking schemes under each scenario of water price and rebate status. The distance based network reached equilibrium in a shorter period. The peer effect through neighbouring social connections can speed up technology adoption potential more than other social networks.

		additionally be positively influenced by the network which also induces a transition.				
Talebian & Mishra (2018)	Forecast long-term adoption of connected autonomous vehicles (CAVs) and show the applicability of the approach is using survey data.	Individuals decide to adopt when (1) there is a need for a new vehicle, (2) their WTP is greater than the CAV price, and (3) their overall impression about CAVs reaches a cut-off value. Agents update their perception about CAVs based on advertisement and peer-to-peer communication.	Exogenous network: 8-dimensional distance minimization in social space	The influence depends on the number of binary interaction between the two agents and the weight of the social tie. Depending of the opponent being satisfied or dissatisfied the influence is positive or negative. Similarly, the willingness-to-pay (WTP) is updated.	Agent-centric: Effect of annual rate of CAV price reduction, (pre-introduction) advertisement, peer-to-peer communication on WTP and probability of becoming a dissatisfied adopter on CAV adoption	The automobile fleet will be near homogenous in about 2050 only if CAV prices decrease at an annual rate of 15% or 20%. A 6-month pre-introduction marketing campaign may have no significant impact on adoption trend. Marketing will ignite CAV diffusion but its effect is capped. CAV market share grows with the effect of peer-to-peer communication of WTP.
Wang, Zhang, Li, & Li (2018)	Assess households' decision-making process towards the adoption of residential photovoltaic (PV) under different scenarios about policies that concern both the economic benefits and the information diffusion on social networks.	Agents are either adopters or non-adopters of residential photovoltaic and have a positive or negative attitude towards the technology. The decision to adopt residential PV is made at each time-step if the utility to the household outweighs the adoption barriers. The utility is a combination of economic factors, social effect and personal preference. Before the decision-making process agents assess the revenue and quality information of PV and can change their attitude accordingly.	Exogenous network: Scale-free	The social effect is the average of the attitude of the adjacent nodes. Revenue information includes the expected revenue according to the experience of their friends. Quality information includes the risk probability according to the performance of friends' residential PV.	Agent-centric: Effect of policy scenarios (with parameter variation) on adoption of residential PV	Providing free insurance for damage of residential PV to adopters can improve the adoption rate. The intervention of information campaigns is effective and necessary to promote the diffusion of residential PV. Information screening intervention which blocks rumours and deliberately discrediting for residential PV can only work when the policy strength is high enough. The enhancement in communications (increase of social networks' mean degree) can become new barriers to the residential PV adoption.

Zhang & Nuttall (2011)	Study the impact of policy options on the dynamics of smart metering diffusion in retail electricity markets and suggest policy implications.	Based on Theory of Planned Behaviour, consumer agents exchange opinions with other consumers and electric supplier agent and adopt the energy supplier towards which their intention is maximal.	Exogenous network: Small-world (based on lattice network (parameter defining radius of interaction))	Subjective norm towards choosing an option is calculated as the sum of weighted influences from residential electricity consumer agents in the neighbourhood.	Agent-centric: Effect of different policy options on the patterns of diffusion	"S-curve" pattern of technology adoption is reproduced for all policy scenarios. The most successful scenario is the government financed competitive roll-out. A stable market share of electricity supplier agents appears. Residential electricity consumer agents switch electricity supplier agents dynamically.

Social dynamics

Reference	Research focus	Agent decision-making	Interaction topology	Network effect	Model analysis	Key findings
Biondo, Pluchino, & Rapisarda (2018)	Study the impact of news media and public surveys on the electoral campaigns for political competitions.	Agents favour one of two political parties (or are undecided). Their preference is influenced by a randomly chosen opinion of one of their neighbours. Additionally, their opinion is influenced by survey results.	Exogenous network: Small-world (based on lattice network (von Neumann))	Agent's opinion is influenced by one randomly chosen agent in their network. The value, corresponding to the party the chosen neighbour favours, is changed by a given amount.	Agent-centric: Effects of survey on electoral campaigns	Surveys accentuate the spontaneous clustering of voting intentions emerging among people due to the opinions dynamics. Surveys can change the final electoral result and let the party, that otherwise would lose, to win the electoral competition.
Bravo, Squazzoni, & Boero (2012)	Investigate the importance of the endogenous selection of partners for trust and cooperation in market exchange situations, where there is information asymmetry between investors and trustees. (social integration)	Agents decide on the amount to invest and return based on the amounts invested and received in the previous period and coefficients estimated from experimental data	Exogenous and co-evolutionary networks Exogenous networks: Experimental data as input with variation of characteristics: random coupling with one and two way interaction, fixed couples (maintaining	Agents exchange money being either in the role of the investor or the role of the trustee	Network-centric: Comparison of network structures (especially distinguishing exogenous and co-evolutionary networks)	Dynamic networks lead to more cooperation when agents can create more links and reduce exploitation opportunities by free riders. The endogenous network formation is more important for cooperation than the type of network.

			initial couples), fully connected, small-world, scale-free Co-evolutionary networks: Initially random coupling, fully connected network or regular network; unsatisfied agents can break the link, new links are included either for both of the formerly linked agents or only for isolated agents			
Chica, Chiong, Kirley, & Ishibuchi (2018)	Investigate the dynamics of the N-player evolutionary trust game consisting of three types of players: (1) an investor, (2) a trustee who is trustworthy, and (3) a trustee who is untrustworthy.	Each player makes the decision (1) whether or not to be trustworthy and (2) whether to be an investor or a trustee. An investor pays to the trustee. Trustworthy trustees return the received fund multiplied by a factor. Untrustworthy trustees return nothing but keep for themselves the received funds multiplied by a factor. Agents decide on which strategies to choose based on the wealth of a randomly chosen neighbour.	Exogenous networks: Scale-free (varying density), lattice (von Neumann), random	An agent decides whether to imitate or not a randomly chosen direct neighbour's strategy based on the payoff of its strategy. If the wealth of the opponent in the previous time step is higher than that of the agent if will adopt the strategy of its opponent with a probability that depends on the difference between their payoffs.	Agent-centric/Network-centric: Parameter variation: Temptation defect ratio, trustworthiness Comparison of network structures	Trust can be promoted with the model for low and medium temptation to defect, for high level of temptation to defect trust is only promoted when no untrustworthy players are present in the initial population. Without a network structure, even one untrustworthy player can fully eliminate investors and lead to zero global net wealth. Network densities have high importance for promoting trust and global net wealth.

Flache & Macy (2011)	Show the effects of positive and negative valences of interaction and short- and long-range ties on polarization or consensus in disconnected and connected networks.	All agents execute influence based on the weighted difference between positions.	Exogenous networks: Disconnected/ connected caveman graph with short- and long-range ties added at different time points of the simulation	Agents are influenced by aggregated opinions of all neighbours in network	Network-centric: Effect of cave size, number of cultural issues, negative valence of interaction and additional short- and long-range ties on polarization	With only positive influence and selection, long-range ties promote greater cultural integration and assimilation. When both positive and negative valences of interaction are assumed, long range ties become conduits for the spread of locally developed polarization and the effect is reversed. In connected networks, when only positive influence and selection are assumed, consensus is the inevitable outcome. Neither long-range nor short-range ties have an effect on the level of consensus. When both positive and negative influence and selection are allowed, long-range ties increase polarization sharply, but short-range ties do not.
Frank, Xu, & Penuel (2018)	Attend how an external agent's message (policy-aligned or balanced) interacts with intra-organizational network dynamics to affect the distribution of practices and network structure within an organization.	If actors receive new information from their network connections, actors adjust their behaviours based on information and norm. Actors decide whether to maintain current network connections and if actors decide to dissolve a current connection, they from new connections.	Co-evolutionary network: Initially random network with higher connection probability within the two subgroups than between; links deleted based on how many consecutive times an actor is exposed to redundant information from the network connection, links formed based on utility to connect with every other actor in the organization while	Each member of an actor's network randomly provides one piece of information in their possession to the actor. If the information is new to the actor, the actor will add this piece of information to its own information list. Actors choose their behaviour according to their previous behaviour, new information they receive and the mean behaviour of their network members. Depending on the	Agent-centric: Parameter variation: organizational identification for two levels of influence Comparison of policy-aligned and balanced messages with baseline case (no external message)	When organizational identification is high, those predisposed to a policy-aligned message will engage the message and one another, becoming more extreme in their behaviours. Others not predisposed to the message will divert away from the message. This produces a divergence of behaviour based on predisposition and little overall change. Divergence does not occur even when organizational identification is high for a balanced message, which provides opportunities for actors to integrate. The trade-off is that the balanced message does not generate as large changes in average behaviour as does the policy-aligned message when organizational identification is low. Thus, when organizational identification is low, a balanced

			keeping the out-degree constant	strength of organizational identification, more or less weight is given to the influence of the network or on own information. Another parameter determines the strength of normative influence relative to that of selection.		message may be a missed opportunity to shape behaviour.
Z. Fu & Hao (2018)	Explain migration perpetuation and social network structural changes in China. Investigate the effects of the endogenous social network on the accelerating migrant stock during the 1995-2000 period.	Agents are classified in three migratory propensity groups according to their demographic attributes. The migratory propensity updates according to the migration-promoting influence and the influence of arable land. Migration-promoting influence varies with the level of impact of the network in different stages of the model (no network, implicit social network using the migration prevalence of the origin, explicit social network structure). If the migratory propensity is greater that the migratory threshold the agent decides to migrate out of the origin.	Co-evolutionary network: Four layered network: (1) fully connected network for observed family ties from the 2000 census micro data, probability for connecting to other families (2) within village, (3) between villages and (4) between migrants in the same destination with probability for adding further ties to create complete graph for selected connection Social network co-evolves with migration decision.	In the case of network impact, the migration-promoting influence depends on the geodesic distance from a migrant of the same origin in the agent's network.	Network-centric: Comparison of outcomes of different levels of network impact and aggregate data from the census Effect of social network structure on migration acceleration.	Network structural changes are essential for explaining migration acceleration observed in China during the 1995-2000 period.

Garcia, Roux, Martins, Yang, & Florindo (2018)	Explore how the interactions between psychological attributes and built and social environments may lead to the emergence and evolution of leisure-time physical activity (LTPA) patterns among adults. (social integration)	Agents decide whether they will practice LTPA during the current week, based on the level of intention and conditional to the perceived built environment. Persons and LTPA-places are placed randomly over patches of a grid. Person's intention to practice LTPA depends on the behaviour of those in the proximal network and perceived community, the person's behaviour in the previous week, current level of intention and the highest perceived utility amongst the LTPA sites in the person's perception radius.	Exogenous networks: Proximal network: Spatial, each link can be randomly exchanged for a link with any other person outside the initial proximal network Perceived community: Spatial (perception radius)	Person's intention is increased or reduced due to the average behaviour of all agents in the proximal network/perceived community times a function of the conditional likelihood that people in the proximal network/perceived community will practice LTPA if it is the best option.	Agent-centric: Parameter variation: Level of intention Individual and global sensitivity analysis	Time trends of LTPA practice and population distribution of levels of intention are similar those reported in literature. Influence of the person's behaviour in the previous week over his current intention, the size of the person's perception radius, and the proportion of patches in the grid that are LTPA sites significantly influence the temporal trends in the model.
Gore, Lemos, Shults, & Wildman (2018)	Forecast changes in religiosity and existential security among a collective of individuals over time. (social integration)	Agents update their religiosity based on social network interactions. Additionally, agents interact with the environment by checking if their value for existential insecurity is below the existential security value of the environment.	Exogenous network: Algorithm reproducing social networks observed in the wild	The extent to which the variable is influenced is determined by a time-dependent weighed average.	Agent-centric: Comparison of the accuracy of predictions from competing approaches (baseline based entirely on historical data, Linear Regression, ABM) for countries on which models where trained/not trained	For a given country and a given time period, the ABM provides a more accurate forecast of changes in the existential security and the religiosity than the two alternative approaches for a specific time period for specific country.
Growiec, Growiec, & Kaminski (2018)	Identify the key mechanism allowing the social network structure to affect individuals' social trust, willingness to cooperate, economic performance and	Agents are matched in pairs and engage in economic interaction. The matching is random but the probability of a match depends on the degree of mutual trust between the two agents, implying that agents who are generally more trustful are also relatively	Exogenous network: Small-world (varying density)	Probability that agent will choose to cooperate is negatively related to the distance to the opposing agent in the social network and positively related to	Network-centric: Effect of network density, inverted probability of local cliques, and the inverted share of local cliques that are	Societies that are better connected, exhibit a lower frequency of local cliques, or have a smaller share of family-based cliques, record relatively better aggregate economic performance. As long as family ties are sufficiently valuable, there is a trade-off between aggregate social utility

	social utility, and trace how these individual-level outcomes aggregate up to the society level. (social integration)	more likely to engage in economic interaction.		the decision maker's bridging social capital.	family-based on average economic performance in the society	and economic performance, and small world networks are then socially optimal. In dense networks and trustful societies, there is a trade-off between individual social utility and economic performance; otherwise both outcomes are positively correlated in the cross section.
Hadzibeganovic, Stauffer, & Han (2018)	Study the effects of phenotypic diversity, network structure, and rewards on cooperative behaviour in a population of reproducing artificial decision makers playing tag-mediated evolutionary games. (social integration)	Depending upon the tag colour of the neighbouring opponents, agents decide whether to cooperate or defect in Prisoner's Dilemma-like pairwise interactions. Ethnocentric agents will cooperate only with neighbours who share the same tag colour, cosmopolitans will provide help only to others displaying a different tag colour, altruists will always cooperate, and egoists will always defect. Each cooperation act is related to a reduction of the reproductive potential of the donator and an increase of the reproductive potential of the receiver.	Co-evolutionary networks: Lattice (von Neumann), small-world (based on lattice network) Networks change due to reproduction and death	Agents chose one of their neighbours to play pairwise Prisoner's Dilemma and decide whether to cooperate and defect based on their attitude which influences the reproduction rate of the receiver and themselves.	Agent-centric/Network-centric: Parameter variation: number of tag colours, length of reward frame Comparison of behavioural strategies Comparison of network structures	Small reward frames promote unconditional cooperation in populations with both low and high diversity. When the reward frame is large, there is a strong difference between the frequencies of conditional co-operators populating rewired versus non-rewired networks. In a less diverse population, the total number of defections is comparable across different network topologies; in more diverse environments defections become more frequent in a regularly structured than in a rewired, small-world network of contacts.
Ke, Gong, & Wang (2008)	Simulate language change as a process of innovation diffusion. Examine the effect of four different network types, different types of learners and the network size on the diffusion.	Agents decide which language (unchanged or innovative) to use based on the frequencies of users of the two variants in their network and the functional values of the languages	Exogenous networks: Ring, random, small-world, scale-free	Agents evaluate the frequencies of users of the two variants of the language in their networks	Agent-centric/Network-centric: Effect of different types of learners and network size on the diffusion Comparison of network structures	Innovations always diffuse to the whole population as long as the advantage of the innovation over the unchanged form is high enough. The success rates and the speed of the diffusion vary across the different network structures. The presence of statistical learners who can learn and use both linguistic variants increases the probability for linguistic innovations. Population size has an

						influence on the diffusion only in regular networks.
Keijzer, Mas, & Flache (2018)	Analyse the implications of one-to-many communication (as present e.g. in online social networks) on the population using Axelrod's model of cultural dissemination as an example.	The social influence component of Axelrod's model of cultural dissemination is adapted to a one-to-many communication: Randomly selected agents from the population communicate one of their features on which they differ with at least one neighbour.	Exogenous networks: Lattice (Moore), spatial, ring (rewired following an algorithm which decreases network transitivity while preserving the degree distribution)	Neighbours adopt the feature with a probability equal to the proportion of traits that they share with the communicating agent.	Network-centric: Comparison of the one-to-one and the one-to-many communication regime for different scenarios in different network structures	One-to-many communication fosters the isolation in bigger populations. Network transitivity fosters the emergence of isolated individuals and cultural clusters. These findings hold for network topologies that mimic the structure of real social networks.
Laifa, Akrouf, & Mammeri (2018)	Study the consequences of different trust dynamics with forgiving and unforgiving strategies after an offense. (social integration)	Offenses occur between two connected agents. Agents can react on these offenses with two different strategies: Either the network is updated by deleting the affected relationships considering neither relationships characteristics nor forgiveness or the trust value is reduced.	Co-evolutionary network: Initially random (size 10^2 and 10^3 and connection probability 0.05 and 0.1); links are weighted by trust which is influenced by offenses that occur in the network, links are deleted if trust value falls below a threshold	Between connected agents a specific number of randomly assigned offenses occur. Agents react on these defences and thereby modify the network structure.	Agent-centric/Network-centric: Effects of network structure on average degree, average betweenness centrality and density of the networks after revaluating trust with both forgiving and unforgiving strategies	The average degree decreases for all the networks and with both strategies. When the number of links in a network decreases, the density of the network declines as well. The network density lessens more for the first strategy, where networks became very sparse, compared to the resulting networks from the second strategy in which they were relatively dense. For betweenness centrality, oscillating curves can be observed for all the networks and with both strategies.
Lou-Magnuson & Onnis (2018)	Simulate how human languages may change over time across a social network of speakers.	Speakers select a signal from their active repertoire and present it to their partner (hearer). The Partners use their passive repertoire to see if they know that signal or search the passive repertoire for a significantly close signal of the same meaning. If a signal in an agent's passive repertoire can be found such that the signal being shared with it is	Exogenous networks: Fully connected, random (different connection probabilities), hierarchical, scale-free	Agents exchange linguistic signals in agent-agent communication.	Network-centric: Effect of transitivity (different connection probabilities in random networks) and network topology (complete, hierarchical, scale-free, random network) and network	Transitivity is critical for the evolution of compositional structure. The hierarchical patterning of scale-free distributions is inhibitory.

		intelligible, the agent adds it to the passive repertoire if not already present. If a signal cannot be found in the passive repertoire, the speaker will try and repair the communication by using any other active signals it possesses with the same meaning. After a set number of communication events, each agent undergoes a replacement process that simulates intergenerational transfer.			size on linguistic reanalysis	
Lozano, Antonioni, Tomassini, & Sánchez (2018)	Simulate Prisoner's Dilemma (PD) games where reputation can be faked and compare the results to experimental work. Simulate much larger population sizes over longer times and test other model parameters to see whether the observed behaviour generalizes in those conditions that cannot easily be conducted in experiments.	Agents receive a random sequence of past actions to determine their initial cooperation index. Agents receive information on the cooperation index of their current neighbours and select cooperation or defection as action for all PD games with their neighbours with probability proportional to the average cooperation index of their neighbours. In selected simulation runs, cheater are introduced that defect with fixed probability.	Co-evolutionary network: Random regular graph; links deleted based on how many times the agent cooperated, new link created randomly	Agents play PD games with all their neighbours and select cooperation or defection based on the average cooperation index of their neighbours.	Agent-centric: Comparison of simulated and empirical results for real and faked reputation Parameter variation: Number of participants, time frame	Comparison between numerical simulation results and laboratory experiment leads to good qualitative fit. Larger populations essentially behave in the same qualitative manner as the small one, except that all results have smaller fluctuations.
Lu, Korniss, & Szymanski (2009)	Study how the community structure of the underlying graphs affects the emergence of meta-stable or long-living opinion clusters.	Speakers transmit a word from their lists to listeners who add it to their list if they do not know the transmitted word or both players delete all other words and agree on transmitted word if listeners know it.	Exogenous networks: Empirical data (high-school friendship network), small-world with same number of nodes,	Speaker transmit words to randomly chosen listeners from network	Agent-centric/Network-centric: Effect of different selection methods for committed agents	Networks with strong community structure hinder the system from reaching global agreement; the evolution of the Naming Game in these networks maintains clusters of coexisting opinions indefinitely. Small number of committing agents is

	Investigate how choosing committing agents and external influence facilitate convergence to global consensus.		average degree and clustering coefficient		and strength of external influence on community structure Comparison of network structures	sufficient to facilitate an exponential decay toward global consensus of the selected opinion. Global external influence leads to an increasing rate of convergence.
Neal & Neal (2014)	Explore whether in network formation respect for diversity and sense of community can both be achieved following the principles of homophily and proximity.	Agents form links with each other based on a logistic selection function depending on their similarity and physical distance weighted by the direction and strength of the tendency towards homophily and proximity.	Endogenous network formation	Agents establish links based on their similarity and physical distance and their tendency towards homophily and proximity.	Evaluation quantity: Relationship between diversity and sense of community depending on the weight given to the direction and strength of the tendency towards homophily and proximity	It is not possible to simultaneously promote respect for diversity and sense of community in a world where relationship formation is driven by homophily and proximity.
Piedrahita, Borge-Holthoefer, Moreno, & Gonzalez-Bailon (2018)	Analyse the contagion dynamics that emerge in networks when repeated action is allowed, that is, when actors can engage recurrently in a collective effort. Investigate how the structure of interdependence, the variance in individual propensities to activate and the strength of social influence affect contagion and the emergence of large-scale coordination.	Agents' propensity to participate in collective events depends on their intrinsic motivation (how quickly they reach the activation limit (and on their social influence (strength of signals received from other agents). When nodes activate, they shift the state of their neighbours and reset their own state back to the beginning phase. If an actor is activated, connected actors' activation increases by a fixed amount.	Exogenous networks: Random, ring, small-world, scale-free	Agents influence their neighbours when activated towards a higher level of activation.	Agent-centric: Effect of intrinsic motivation and social influence for homogeneous and heterogeneous distribution of the intrinsic motivation on time to coordinate	Homogeneous networks (degree distribution not significantly skewed) are more conducive to coordination. There is a critical value for social influence for all topologies and levels of intrinsic motivation below which actors do not achieve coordination.

Schlaile, Knausberg, Mueller, & Zeman (2018)	Illuminate the influence of particular social network characteristics on the ALS Ice Bucket Challenge's (IBC) diffusion.	The simulation is initially seeded by five randomly chosen initiators who already performed the IBC. Each agent who accepted the challenge nominates three of its neighbours who have not previously accepted the IBC. Agents are resistant against the challenge with a factor drawn from a random distribution in a fixed interval. Each time an agent is nominated, its resistance value is reduced by another value, determined as the effect of nomination. If an agent's resistance is reduced to zero or lower, the agent will accept the challenge.	Exogenous networks: Scale-free, small-world, random	Agents nominate three neighbours from their network to participate at the challenge. The nomination reduces their resistance against the challenge.	Agent-centric/Network-centric: Parameter variation: Mean resistance against the challenge Comparison of network structures Effect of average degree and celebrities	The model can qualitatively reproduce central elements of the empirically observed IBC's diffusion pattern. The IBC has to reach a critical mass of carriers in order to stall prematurely. Networks with a high average clustering coefficient as well as a moderate average degree are beneficial for the IBC meme's diffusion performance. The assumption that hubs have a higher influence on others leads to a faster and more wide-ranging diffusion of the IBC in networks exhibiting a highly skewed degree distribution.
Simão & Todd (2002)	Study mate choice in monogamous mating systems and evaluate performance and robustness of different agent strategies.	Agents decide on whether to initiate relationship or switch partner based on (1) the age and quality of the potential and current partner and the focal agent and (2) their aspiration level.	Co-evolutionary network: Pairs of male and female meet at certain stochastic rate, agents switch between single and courting state based on the quality of the partner and their aspiration level	Agents try to find optimal partner based on the properties of the other agents and their aspiration level.	Agent-centric: Comparison of the efficiency of the different mating strategies Comparison of the predictions of the model with theories from social sciences	Being able to switch partners during a courtship period is superior to courtship without partner switching.
Son & Rojas (2011)	Understand how team networks evolve over time and affect performance. (social integration)	Agents participate in social interactions with a probability determined by their familiarity towards the other agent. Agents choose whether to cooperate or to defect from a newly met agent based on comparison of the current payoff that they are	Co-evolutionary network: Social interactions with probability depending on familiarity, links created and deleted	Agents get payoff from relationships with other agents which they try to maximize. Agents' behavioural dynamics and overall network dynamics co-evolve	Agent-centric: Effects of costs for relationships with other agents from same or different group and for familiarity	The fewer individuals are familiar with others in the network, the more time it takes for networks to reach stable states. The tendency of cohesion increased as the effort to form relationships with outside partners rose. The more effort needed to from relationships with those from other

		attaining from a combination of existing partners and the potential payoff that they could achieve by forming a new relationship with the candidate partners and severing the least efficient relationships.	based on expected payoff, maximum number of connections limited	during interaction. When two agents meet, their familiarity with one another increases.		organizations, the less efficient the networks were.
Weng, Flammini, Vespignani, & Menczer (2012)	Study whether competition among ideas may affect the popularity of different memes, the diversity of information we are exposed to, and the fading of our collective interests for specific topics.	Agents spread information with fixed probability. The information is either chosen from the memory of the agents (records posted memes) or from the screen (records received memes).	Exogenous networks: Random, sampled graph from Twitter follower network, empirical data with only retweets	Spread of information between connected agents with probabilities depending on the source of the information	Network-centric: Effect of network structures and meme competition (length of time window until meme is removed) on meme lifetime, meme popularity, user activity and breadth of user attention	The massive heterogeneity in the popularity and persistence of memes can be explained as deriving from a combination of the competition for our limited attention and the structure of the social network, without the need to assume different intrinsic values among ideas.
Zhuge, Shao, & Wei (2018)	Generate both close and somewhat close social networks separately for a synthetic population containing individuals and their attributes and locations and compare the networks to survey data from Beijing, China.	Agents built and resolve friendships based on a utility function which incorporates the similarity between a pairs of agents and the spatial closeness of their residential locations and workplaces.	Endogenous network formation	A social network is generated by fitting the degree distribution and the transitivity distribution considering a utility function of the similarity between the agents.	Evaluation quantity: Generation of close and somewhat close social networks	Close and somewhat close social networks generated for Beijing exhibit a good ability to match target and generated distributions of network degree and transitivity.

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