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Social Simulation for a Digital Society

Applications and Innovations in
Computational Social Science

 Springer

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This book is dedicated to Assoc. Prof. Diane Payne, our dear colleague who passed away in early 2019. The Social Simulation Conference 2017 in Dublin, which she was instrumental in organizing, was subtitled: Social Simulation for a Digital Society. This motto expressed Diane's conviction that sociology would gain from using computer simulation and taking advantage of the increasing availability of data. Throughout her life, particularly during her tenure at University College Dublin, she promoted the use of quantitative methods in sociology as the Director of the UCD Dynamics Lab at the UCD Geary Institute for Public Policy and as Head of the School of Sociology. She was passionate about the opportunities offered that allowed and facilitated new collaborative research approaches between scientists, industry, and government – while involving different disciplines within UCD and other universities worldwide. She kept an open mind and an insatiable curiosity that allowed to constantly further develop analytical and modeling approaches. Through the European Social Simulation Association, she developed a professional network that shared her ethos, and she made sure that this research network did benefit from every opportunity available to staff and students. She was a pioneer in her field, and she is dearly missed. We are sure her professional legacy will continue to inspire the work of scientists across the world. Thank you, Diane.

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Chapter 1

Social Simulation for a Digital Society: Introduction



Diane Payne, Johan A. Elkink, and Thomas U. Grund

An increasingly popular strand of social science research attempts to understand social facts (e.g. segregation, social inequality, cooperation, opinions, social movements) not merely by relating them to other social facts, but rather by detailing how relatively simple interactions between individuals and groups (agents) combine and lead to the emergence and diffusion of social patterns (Squazzoni 2012; Macy and Willer 2002). Simulation models to investigate such interactions have been around for decades in the social sciences, for example Schelling's (1978) model of social segregation or Axelrod's (1986, 1997) model of the evolution of cooperation, but only became more common as the computing power accessible to the typical social scientist increased.

A computational agent-based model is a model in which the patterns are studied that result from the interaction between large numbers of actors on the basis of a relatively simple set of behavioural assumptions, simulated in a computer environment. For example, some simple assumptions about the likelihood that a fish of a certain size will eat another fish, the likelihood that a fish will reproduce, and the likelihood that a fish will naturally die, can be modelled in a computer simulation, the analysis of which can provide useful insights in the ecology of fish, which are difficult to trace using other methods of modelling or simulation (DeAngelis and Rose 1992). These models are generally based on assumptions of non-linear relations between variables, due to the fact that actors both create or form their environment, while their environment affects their individual behaviour. The behaviour of

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an individual agent is thus dependent on that of many other agents previously, which creates complex patterns not easily deductible from the individual rules of behaviour of the agents.

Such an approach overcomes the often falsely assumed dictum that individuals (or observations) are independent from each other. What is often regarded as a nuisance in many statistical analyses receives a full spotlight in social simulation studies. Social influence, feedback loops, tipping points, unintended consequences and the emergence of social phenomena from the ‘bottom-up’ take pivotal roles. Individual-level behaviours are investigated in the light of preceding social conditions (macro-micro relations).

At the same time, emphasis is put on how the behaviours of individuals combine and generate the social outcomes we observe (micro-macro relations). The effect of fairly straightforward interactions between individual members of a mass of people can have very complicated and often unexpected effects on the mass behaviour as a whole. For example the simple behaviour of a car driver, slowing down for cars in front of him or her and speeding up when there is a chance can, given different initial speeds of different cars on the road, easily lead to traffic jams. Simply slowing down for people in front does not trivially lead to traffic jams, yet such behaviour, given the diversity in speeds, does have this effect. Moreover, placing traffic lights on a road even without any crossroads can reduce the chances of a traffic jam because they have the effect of homogenizing the speeds of the cars – they all start at the same time at similar distances from each other when the light turns green. Therefore the intuitively contradicting idea of stopping cars to avoid traffic jams can actually be quite successful. This example illustrates in a simplistic way how individual behaviour can have unexpected macro effects and this link between local, individual behaviour and global, macro behavioural patterns thus deserves attention in social science research.

Computer simulations rewind history, investigate how social processes unfold and how starting conditions or interaction structures influence social outcomes. This breaks with traditional conception and thinking, emphasizes social dynamics and disconnects the sizes of causes and consequences.

Social simulation is a powerful tool to understand the macro-implications of micro-level dynamics. But it also allows the simulation of what-if scenarios. How would the world look like if a certain policy would be implemented? How would a market change if interaction rules for market participants would be altered? How would traffic change if a train line would be built? Answering such questions are not trivial in highly dynamic and complex social systems. Small changes can have huge implications and the sizes of causes and effects are often not proportional to each other anymore. Furthermore, real-world experiments are not always feasible or too costly. One cannot simply try out different locations of a subway stop in the real world, but one can simulate different scenarios.

As more and more scholars embrace computer simulations in the social sciences, there is also an expanding academic community in this field. This volume builds on a variety of contributions, first presented at the European Social Simulation Association Conference, hosted in Dublin in 2017. These contributions vary from philosophical considerations underlying this methodology, to methodological and technical contributions, to applications in particular in the domain of spatial social dynamics.

Chapters 2–4 deal with philosophical and technical considerations in social simulation studies. In the first contribution, Lia ní Aodha (Chap. 2) discusses the use of qualitative data to inform agent-based models. Her critical reflection provides a discussion of the ontological assumptions in agent-based modelling and qualitative research in order to outline potential incompatibilities. In Chap. 3, Jonathan Thaler and Peer-Olaf Siebers develop a classification of agent update-strategies – i.e. the timing and sequencing of updates and messaging between agents. Applying different update-strategies to well-known models, they illustrate the impact a modelling decision for one or another update-strategy might have. And then, Patrick Taillandier, Mathieu Bourgeois, Alexis Drogoul and Laurent Vercouter (Chap. 4) provide a contribution where an existing modelling framework is altered to allow for parallelization. Using examples from the platform GAMA, they demonstrate how parallelization can be achieved and how much faster it makes simulations.

Chapters 5–8 apply social simulations to norm diffusion and collective action. Kyle Bahr and Masami Nakagawa (Chap. 5) develop a model where network ties are created through communication and continued communication strengthens network ties. Communication is affected by agents' level of influence, which is set by the centrality in the communication network. In Chap. 6, Emiliano Alvarez and Juan Gabriel Brida model individual agents on a regular grid, who change their opinion, based on personal preferences, neighbour's opinions, and random mutation. Christopher K. Frantz and Amineh Ghorbani (Chap. 7) models the impact of inequality on the sustainability of protest. While it is – that inequality matters for the initiation of protest, much less is known about its impact on sustainability. In Chap. 8, Oswaldo Terán, Christophe Sibertin-Blanc, Ravi Rojas and Licia Romero expand on an existing model to investigate the interests and inter-play between different actors in the potato seeds market in Venezuela. Their simulations give insights into different policies and configuration options that would create a fairer market.

Chapters 9–14 provide application of social simulations to geography and urban development. Johannes Weyer, Fabian Adelt and Sebastian Hoffmann (Chap. 9) model traffic behaviour on a network of connections with nodes such as homes and work locations, and different parameters for agents that affect route selection. Demonstrating the usefulness of their model, while allowing for the addition of different types of actors, it shows the impact of different governance regimes. In Chap. 10, Liu Yang, Koen H. van Dam, Bani Anvari and Audrey de Nazelle provide an agent-based model to simulate traffic in Beijing, which is then compared to actual traffic data from Google Maps. In particular, they focus on the upgrade of a train line that cross-cuts a large part of Beijing. In Chap. 11, Hideyuki Nagai and Setsuya Kurahashi present an agent-based model for arranging transport methods and leisure facilities in different ways in a commuter town and work centre. Their model identifies measures that could affect compactification, car use and CO₂ emissions. Laura O. Petrov, Brendan Williams and Harutyun Shahumyan (Chap. 12) provide a discussion of engagement between stakeholders, policy-makers, and modellers in the context of urban and rural development modelling in a particular region in Ireland. Gillian Golden (Chap. 13) also focuses on Ireland and discusses

procedures that can be used to create a synthetic population of children in Irish schools that match marginal statistical data available at regional or school level, using simulated annealing and various proposed goodness of fit measures. And lastly, Martina Neuländtner, Manfred Paier and Astrid Unger (Chap. 14) explore the impact of increased collaboration between firms as assessed by patent quantity. Increasing collaboration does not have a positive impact per se, since it is difficult to find suitable partners, but increasing national-international collaboration increases opportunities for diversity and avoids lock-in, which leads to innovation and more patents.

Sadly, one of the organizers of the European Social Simulation Conference 2017 and the main editor for this volume – Diane Payne – unexpectedly died in early 2019. Diane was a prominent figure in social simulation studies, both in Ireland, but also abroad. We wanted to finish publishing this volume in her name and dedicate it to her. She will be missed.

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Part I
Philosophical and Technical
Considerations

Chapter 2

Ontological Politics in a World of Political Ontologies: More Realistic (Human) Agents for the *Anthropocene*?



Lia ní Aodha

“VARIETY DISAPPEARS when subjected to scholarly analysis.”

(Feyerabend 2001, p. 12)

Introduction

Given the “character of calculability” of the twentieth century (Mitchell 2002, p. 80), and the widespread propensity to *hyper*-quantification (Denzin 2017), alongside the mounting evidence with respect to the societal and ecological damages this has entailed (Pilkey and Pilkey-Jarvis 2007), adopting a qualitative approach to building agent-based models (ABMs) seems downright reasonable. In this sense, “getting away from numbers” (Yang and Gilbert 2008, p. 275) would certainly appear to have some merit. Nevertheless, this effort does invite critique. Some of these relate to the practice of modelling itself, whilst others are of a more general nature and are similar to those that have arisen in other collaborative research endeavours. In this sense, they may be placed within the context of a broader politics of representation, and of knowledge. It is argued here that consideration of these overlapping issues necessitates, in the first instance, reflection on the wider contextual backdrop against which these politics are unfolding, and within which complex computer simulations are gaining increasing precedence. Subsequently, whilst drawing attention to the embeddedness of *all* knowledge, including that which is operationalised through complex simulations, a number of philosophical and sociological critiques of agent-based modelling (ABM) are made. Here, questions are posed with respect to the assumptions underpinning ABMs, and the level of simplification they entail. In turn, the case is made for the importance of situated knowledge, whilst the *potential* colonising effect of complex computer simulations is both highlighted and cautioned against. Notwithstanding this, an overarching call for pluralism is put forward.

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Complex Problems and the Integration Imperative

In the spirit of this argument, context matters. Backgrounding this critique is an academic and policy environment that, very much focused on complex (social, ecological, socio-ecological) problems, increasingly calls for broad collaboration, drawing across (and beyond) disciplines – from the natural and social sciences to the humanities, and further. These calls themselves, are situated within a wider social, political and ecological *reality* that certainly requires collaboration and, arguably, further extension of that collaboration to different traditions of thought entirely. Given this, this call could (should?) be read as one that requires a plurality of views, and knowledge. The very real anxieties (Robbins and Moore 2013) of this post political moment¹ — increasingly known, though not without contention, as the Anthropocene — require pluralist, non-reductive strategies (Blaser 2009, 2013; Castree 2015; de Castro 2015; Klenk and Meehan 2015; Lövbrand et al. 2015).² In this sense, they might logically be read as necessitating methodological, alongside disciplinary, plurality.

Despite this, these calls and the manner in which they are being answered (once one scratches the surface) seem to betray a polemic, flabby, and defensive character (Bernstein 1989).³ Though couched in collaborative dressing, they have been charged with displaying a methodological monistic hue, an underlying integration imperative (Castree et al. 2014; Klenk and Meehan 2015); with the broad focus in many spaces remaining narrowly centred on the individual (Castree 2015). Far from a fundamental rethink of the *enlightened* — predominantly quantitative, predictive, instrumental — approach to designing nature (Pilkey and Pilkey-Jarvis 2007, pp. 192–193), the guise of social science and humanities work that has gained most salience has been that which has adopted “...quantitative, behavioural approaches that fit the bill of a supposedly ‘objective’ representation...” (Pellizzoni 2015, p. 11). Whilst the picture sketched here is perhaps unsurprising, in the context of a re-emerging and narrowly defined call for “scientifically based research” and

¹Post-politics is taken here to denote the largely consensual vision or arrangement, within which the current institutional setup, problem framings, and proposed solutions are taken as a given (for a more explicated reading see, for example, Ranciere 2001; Swyngedouw and Ernstson 2018; Žižek 2017).

²The contentiously proposed term for the new geological epoch that the Earth has allegedly entered, as a consequence of human (singular and homogenous) activity (Bavington 2011; Lorimer 2017). Interpretations and mobilisations of the concept are many, and an array of alternative (more accurate) renderings exist (for example, Lorimer 2017; Moore 2016; Swyngedouw and Ernstson 2018).

³Bernstein (1989, p. 15) laid out a number of different types of pluralisms: *Fragmentary pluralism* is one in which we fall back into our silos, only willing to communicate within our own safe ‘thought collectives’ (even if they are undisciplined). *Flabby pluralism* is where our pluralisms amount to “little more than superficial poaching”. *Polemical pluralism* is where appeals to pluralism “become little more than an ideological weapon to advance one’s own orientation”, without any real readiness to take others seriously. *Defensive pluralism*, again displays little real willingness to engage beyond mere lip service.

“evidence-based policy” (Maxwell 2004, p. 35; Saltelli and Giampietro 2017), whereby the emphasis is trained upon a narrow rendering of something called “the human dimensions” (Bavington 2011, p. 18; Castree 2015; Castree et al. 2014; Pellizzoni 2015), such a hue and focus sits uneasy in a world of ontological politics (Pellizzoni 2015). Ontology matters (Epstein 2016a). And all ontologies are political!⁴

Agent-Based Models and Qualitative Inquiry

“Qualitative evidence has often been seen as “unscientific”, critiqued as: subjective, biased, unreliable and context-specific. These critiques are not without merit – qualitative evidence *does* have its difficulties – but it also has its own advantages and the difficulties are not sufficient to justify ignoring it” (Edmonds 2015, p. 1).

How does this relate to the question as to whether or not there are critiques to be levelled at the ongoing attempt(s) to utilise qualitative data to inform ABMs? As indicated, there *does* seem to be good reason to suggest that we need to start thinking more qualitatively (Pilkey and Pilkey-Jarvis 2007, pp. 192–193), and ABM does appear to be a good vehicle for incorporating qualitative evidence into complex models. ABM, it is argued, is particularly suited to encoding aspects of qualitative data, thereby allowing for the avoidance of unnecessary quantification (Edmonds 2015). At the same time, qualitative data may go a long way to capturing the micro-level data that is required in building *a* model (Edmonds 2015), and can be hugely beneficial in, subsequently, validating *the* model, given its ability to capture also some contextual macro features which may be verified with the outcomes generated by *that* model (Yang and Gilbert 2008).

So in this sense, yes – *narrative textual evidence* can provide a good basis for informing the behavioural rules of virtual agents, and more. The work in this area verifies this, and most certainly, such an approach can lend a certain realism to a model (e.g. Bharwani et al. 2015). Given that, to date, evidence-driven models remain, somewhat, thin on the ground, adopting a qualitative strategy may go some way to closing this gap (ibid), and satisfy the need to embed models in empirical data (Boero and Squazzoni 2005). Further, and with respect to collaboration, given its capacity to bridge the quali-quantitative divide (Squazzoni et al. 2014), ABM, it is suggested, may be a promising instrument through which traditional disciplinary boundaries might be traversed, thereby potentially offering dividends in terms of plural research endeavours (Squazzoni 2010).

⁴Ontology is used here to denote the assumptions through which we apprehend and depict “reality” (Kohn 2015), with the underlying premise being that when paired with the word politics signifies that the “real” is not necessarily a given, but rather is historically, culturally, and materially situated (Mol 1999).

Notwithstanding this, arguably, a lot of the above argument echoes some of the *potential* dangers of such efforts. For example, taking Edmonds' (2015) quote above, it is true that for some academics, qualitative and quantitative evidence are incommensurable – that's ok, this is in *some ways* simply reflective of different ways of understanding and seeing the world.⁵ Different ways of making sense of the world are important, and it is not at all clear that commensurability is required. Thus, while ABM may be a possible vehicle for bridging this gap, whether or not finding a way where both approaches can be folded in together is or should be the objective for either side of the divide is certainly open to question. Put mildly, in the *Anthropocene*, the politics of evidence and representation matters a great deal, which merits reflection when thinking about questions of commensurability and incommensurability, and with respect to the kind of world that is rendered legible through ABM. These factors are not inconsequential when discussing the potentialities of plural research endeavours. Further, their consideration seems especially pertinent given that there is evidence to suggest that ABM is gaining traction not only across the social sciences (Castree et al. 2014; Squazzoni 2010), but beyond (Government Office for Science 2018; Pellizzoni 2015).

A Philosophical and Sociological Critique

Though there does seem to be a decent amount of evidence that there are gains to be had — certainly in terms of more realistic models — from using qualitative data to inform ABMs, a number of philosophical and sociological critiques may be levelled at ABM, which could render it an untenable approach for many perspectives working within (and around) the social sciences and humanities. In this respect, two issues in particular are raised here: ABM's intentional or unintentional, and often mentioned, but seemingly persistent propensity towards methodological individualism, and its demand for simplification.⁶ The first point here raises questions with respect to the ontological base of models, whilst the second clearly entails limitations in terms of the contextual, deeply situated analysis that is at the core of much qualitative research. Together they elicit a number of questions with respect to the kind of world that is being depicted by ABM, and open discussion for the kinds of depictions ABM might provide otherwise (Holbraad et al. 2014).

⁵Having said that, part of the “ontological turn” across the social sciences has entailed a shift from questioning different viewpoints to posing questions with respect to the reality of different worlds i.e. with respect to ontological multiplicity, rather than epistemic multiplicity (Pellizzoni 2015).

⁶Methodological Individualism – the view that human individuals are the sole, unique, and ultimate constituents of social reality to which all else is reducible (Hay 2013).

ABM's Methodological Individualism

Ontological decisions regarding the kinds of entities we assume to exist, or whether we decide to carry out our inquiry in terms of identities, individuals, collectives, states, regimes, systems, or something else, reflect certain assumptions about 'reality' (Hay 2013). These choices, even if they are only implicit (or we have not even thought about them), have epistemological, methodological, and practical consequences (Hay 2013). In this respect, it has been suggested that ABM and qualitative research, ontologically and epistemologically speaking, are not very removed from one another; with context, time, mechanisms, processes, and sequences of events being important to both (Yang and Gilbert 2008).⁷ Though this may be the case, a number of ontological misconceptions remain widespread in modelling, concerning the relation between macro and micro properties (Epstein 2013, 2016b). Here, the long-standing argument made is that many models display a level of methodological individualism (MI), and a leaning towards a unidirectional micro-to-macro level emergence (Conte et al. 2001; Epstein 2013; O'Sullivan and Haklay 2000; Venturini et al. 2015) that may certainly make some social scientists uncomfortable (e.g. see Bourdieu 1989; Emirbayer 1997; Knorr-Cetina 1988).

Indeed, there *is* much sociological evidence to suggest that such a stance is (at best) limited (Conte et al. 2001; Sawyer 2005), even for basic 'facts' about groups of people (Epstein 2016b). For example, ongoing work within the subfield of social ontology (as elsewhere) makes the case that group intention and action can, and often does depend on more than the individuals within the group – external forces, power, hierarchies, meso- and macro-forces etc. matter (ibid). From an array of perspectives, non-human materialities matter (Elder-Vass 2017; Morton 2013, 2017). Indeed, similar arguments, with respect to *new-materialisms*, have long held traction in and around science and technology studies (STS), and political ecology (e.g. Callon 1984).⁸ Essentially, the premise of MI, whether ontological or explanatory (as is sometimes posited), is questionable (Epstein 2016b). Related premises of weak individualism or structural individualism (Hedström and Ylikoski 2010; Marchionni and Ylikoski 2013) are equally dubious.⁹

Despite this, however, many ABMs seem stuck in and around this assumption. What is less clear entirely, however, is whether this MI (taken as sound or otherwise), is grounded in an ontological commitment.

⁷This statement merits clarification. In terms of underlying assumptions qualitative research is methodologically diverse. Thus, one may reasonably highlight here that some traditions of qualitative research might be quite removed — ontologically and epistemologically speaking — from the representational economy of agent-based models.

⁸From such a vantage point, matter itself is rendered agential. Further, the bounded organism is not the unit of study, rather the focus is on assemblage (MacLure 2017).

⁹Recent discussions of this kind have come from AS (Bulle and Phan 2017; Hedström and Ylikoski 2010). However, Little (2012) has argued that AS, despite postulations with respect to structural individualism, seems to be explicitly grounded in MI, with some possible commitment to methodological localism.

Although *all* research is underpinned by epistemological and ontological assumptions, a lot of models are not explicit about the worldviews and assumptions underpinning them. As Epstein (2013) has highlighted, even though it may not be glaringly obvious that ontological assumptions are important in ABM, they are certainly there – even if only implicitly. In this respect, there seems to be an affinity between the explicit methodological assumptions underpinning the mechanistic perspective of analytical sociology (AS) (Bulle and Phan 2017; Hedström and Ylikoski 2010; Little 2012) and those apparent in ABM.¹⁰ Indeed, Hedström and Ylikoski (2010) have professed such a kinship. However, whether this affinity is bidirectional seems open to question. Put another way, it is unclear whether the MI displayed by many ABMs is simply a symptom of an approach that has “grown up” with a focus on generative mechanisms (Marchionni and Ylikoski 2013) and an ad hoc style, or whether it reflects a broad-based acceptance of the same premises as AS (e.g. Boero and Squazzoni 2005).

A number of different suggestions have been put forth with respect to these issues. Sawyer (in Conte et al. 2001), for example, has suggested that ABM displays this MI largely due to unquestioned assumptions, rather than pragmatic considerations, or empirical evidence. The author further suggests that this is possibly a feature of an earlier relation with economic theory (one does not have to look far to find ABMs with simplistic economic agents, or their bounded cousins), with the field of artificial intelligence (AI), and of cultural biases towards individualistic thinking, more generally. In short, this appears to be an unquestioned assumption rather than a foundational argument (Sawyer, in Conte et al. 2001), as it is with AS. Similarly, Epstein (2013) has argued that (computationally) ABM is not inherently individualistic (i.e. this is not a limitation that is built into ABM, per se). As such, this is something that can perhaps be overcome. In relation to this, however, Epstein (2013) has highlighted that given some of the issues surrounding this are in many instances overlooked completely by the researcher, models often don’t succeed in avoiding even the crudest forms of individualism.

This discussion raises a number of issues relating to the embeddedness of *all* knowledge, and the consequentiality of failing to reflect on our own biases, or our assumptions more generally (even if we do not consider them to be situated). The points raised by Sawyer (in Conte et al. 2001), for instance, give countenance to the argument that context is an important determinant of the manner in which social data (or indeed any data) is rendered (Hacking 1990). How we apprehend and depict the world is grounded “within a larger context of what the individual is, and of what society is” (ibid, p. 4). Here, one might make the case that our predisposition to think at the individual level might reasonably be considered an *affect* of our own embeddedness within the current hegemonic socio-natural configuration.¹¹ With

¹⁰The ontological base of AS is open to many of the same critiques made here (e.g. see Little 2012). That “it makes quite a difference whether the world is viewed as a machine or as a turbulent stream” (Kwa 1994, p. 387) is worth considering here also.

¹¹Margaret Thatcher’s famous quip: “There is no such thing as society. There are individual men and women...” comes to mind here.

respect to both this and the points raised by Epstein (2013), suffice to say that if you fail to recognise that your knowledge is situated, you are unlikely to reflect on it (Berg 2001; Haraway 1988; Rose 1997).

Whichever the case, the proposition that individuals are “a stable and unproblematic source of social action” or “causal agents who produce, mediated by their dispositions and beliefs, a steady flow of social phenomena” (Knorr-Cetina 1988, p. 24) is at odds with *a lot* of perspectives across the social sciences and humanities. Likewise, *any* kind of micro-macro dualism or determinism is going to be problematic, for those sharing the view that the macro and micro cannot be ontologically separated at all, but rather are co-constituted, and this is the case even in an actor-oriented approach that prioritises individual meaning and action (Long and Long 1992). Further, the aforementioned question of embeddedness certainly arises (Granovetter 1985; Polanyi 1944), whilst a relational theorist will reject the notion outright that one can posit discrete, pre-given units such as the individual or society as the definitive starting point of social analysis (Bourdieu 1989; Emirbayer 1997). Indeed, Venturini et al. (2015, p. 3) go so far as to make the claim that “the *last* thing” social scientists need “are models that break them in micro/macro oppositions”, highlighting that empirical evidence shows that social structures do not simply jump up from micro interactions, but rather there is a dialectical relationship of constant flux between and among both of these levels.

Simplification Versus Messy Reality

A further issue to be raised with respect to these models, and which is done so with the recognition that efforts to use qualitative evidence to inform ABMs represent an attempt to closing this gap, is the level of simplification that is required in ABM. In this respect, the points which have been raised in relation to the ontological base of ABM suggest a degree of (rectifiable) oversimplification. However, the level of simplification demanded of formal modelling more generally, is a line of inquiry worth following in considering how far qualitatively driven models might go, with respect to rethinking how we conceptualise and design nature.

In terms of representation, all formal modelling endeavours require a level of abstraction that is quite distinct from, for example, the narrative renderings of the world that qualitatively driven models seek to draw on. That said, it is recognised that ABM fares better than other models on this charge. For instance, unbounded from the constraints of analytical mathematics in a manner that is distinct from other formal models, ABM *does* have the capacity to allow for a “messier” representation (Squazzoni 2010; Squazzoni et al. 2014). Given its ability to deal with qualitative data, heterogeneity, and environmental features (ibid) ABM makes possible a degree of “ontological correspondence” with the real world that other models struggle with (Squazzoni 2010, p. 199). One might highlight here, however, that regardless of what the features of ABM make possible, the discussed ontological

misconceptions that are prevalent in ABM call into question the degree of current correspondence. In terms of simplification versus messy realities, one might also highlight that ABM still suffers a number of limitations vis-à-vis the contextual, deeply situated analysis that is central to much qualitative research, which does call into question the manner in which these two ways of grappling with the world might best be “coupled”.

O’Sullivan and Haklay (2000), for instance, highlight that within ABM there is a strong commitment to minimal behavioural complexity, in order to make the process of modelling feasible, and the resulting model understandable. Similarly, Venturini et al. (2015, pp. 1–2) highlight that models often entail a great degree of simplifying agents, their interactions and emergent structures, with the objective being to *fit* them, raising the issue that from “a methodological viewpoint, most simulations work *only* at the price of simplifying the properties of micro-agents, the rules of interaction and the nature of macro-structures so that they conveniently fit each other”. In short, the demands of formalising a working model — regardless of its ability to grapple with qualitative data or, for example, heterogeneity — does seem to necessitate a manner of reduction, and a level of simplification that is antithetical to the aim of qualitative research. Thus, whilst it is conceded that simplification and abstraction are entailed in all research endeavours and that ABM — in particular qualitatively driven ABM — holds promise in terms of avoiding the level of abstraction demanded of other complex models (Squazzoni et al. 2014), it is not unproblematic in this respect.

Given this discussion, there does seem to be a danger that in the effort to translate qualitative evidence into something that can be used in a model that evidence is reduced to this entirely. That is, reduced to something which can be formalised by the modeller, and put to work within a model. Whilst adopting this strategy may add to the realism of an ABM, it may well miss the point of much qualitative research, and the commitment of such an approach to thick, contextualised description, which is attentive to messy, and everyday realities. Whether a researcher can be satisfied with this level of abstraction is probably down to the individual him or herself. Whether this is the best way to answer questions about the world is certainly up for debate. In Anna Tsing’s (2012, p. 141) words: “there are big stories to be told here” and *attempting* to understand and tell these requires a number of different strategies and methods.¹² In this respect, both ABM and qualitative methods, whilst not incompatible are distinct, each with their own trade-offs and representational capacity. Which raises the question as to how best these stories might be told? Whether they can be told alongside these models? Or whether these models will (further) subsume these?¹³

¹²The term stories is used here to denote, for example, rich and varied narrative accounts about how the world unfolds, that go beyond-the-human. Certainly, beyond the micro-level and the individual.

¹³Here, the consequentiality of hyper-simulation versus hyper-quantification comes to mind.

Colonisation, Collaboration and Depictions Otherwise

Thinking in terms of collaborative versus colonising research endeavours, and considering what “collective intellectual experimentation” (Lorimer 2017, p. 133) might look within this space merits reflection on whether there is room for adopting a real commitment to embracing a plurality of approaches. As indicated, using qualitative data to inform models does seem reasonable, mere synthesis decidedly less so (Klenk and Meehan 2015). Given their capacity to grapple with the world in quite different ways, both ABM and qualitative methods have a certain “added-value” (Squazzoni 2010, p. 21). For example, ABM does have the potential to increase our understanding of “reality” in a manner that might not be readily accessible through direct observation, without the aid of a simulation (Frigg and Reiss 2009; Venturini et al. 2015). On the other side of the coin, there are some ways of knowing the world that model-based formalisation simply eludes, and to this end, there are an array of qualitative approaches available that provide a good route to more critical situated engagements that are not so easily rendered amenable to simulation. Consequently, combining these approaches in a manner that resists descending into a narrow integrating, triangulating, or formalising exercise may well offer a promising route towards generating a deeper, more nuanced, careful understanding (Flick 2004), through the incorporation of “multiple lines of sight” (Berg 2001).

Realising this, however, requires a commitment to proceeding in a manner that is mindful that not all knowledge seeks formalisation, nor is it waiting to be *rendered scientific*. Taking Edmonds’ (2015) quote from the beginning of this section again – yes qualitative evidence is often criticised for being subjective and context-specific. Arguably, however, there is a lot of room for contextually situated knowledge that is attentive to time, space, politics, economics and culture, and can provide us with less formal, and (perhaps) more critical insights into lived experiences and phenomena. The challenges facing society today are not merely scientific, but rather in many instances political, and ethical. Thus, in these instances, the “added value” of “subjectivism and narrativism” (Squazzoni 2010, p. 21) becomes apparent, whilst that of formalisation is somewhat diminished. In terms of this discussion, it is acknowledged that using qualitative data in an effort to empirically embed models does not represent a conscious attempt at colonisation. Nor do ABMs appear to proclaim a capacity to represent reality in totality (Kwa 1994). Albeit unintended, however, it is suggested that this is potentially what is at stake here, particularly when one considers the wider “intellectual climate” (Castree et al. 2014), and politics of evidence (Denzin 2017; Maxwell 2004), alongside the primacy of the role computer models have hitherto been given in representing the *Anthropocene* (Edwards 1999, 2017).