Debate: Social Physics, or the Interpretative Turn? – *peer-reviewed*
Edited by Noortje Marres
https://doi.org/10.60923/issn.1971-8853/24687

Sociologica. V.20 N.2 (2026)
ISSN 1971-8853
https://sociologica.unibo.it/

Is Language Social Action? A Commentary on Language Agents

Michael Castelle*

Centre for Interdisciplinary Methodologies (CIM), University of Warwick (United Kingdom)

Submitted: April 9, 2026 – Accepted: July 7, 2026 – Published: August 6, 2026

Abstract

Recent public and/or intellectual controversies around large language models (LLMs) forcefully demonstrate the relevance of language to social life. In both computer science and computational social science (CSS) research, their development has led to a surge of interest and engagement with the complexity of natural language and its relationship to culture. But what sociological understanding of language can this emergent research draw on? The rise of LLMs — and their use in social simulations of interacting "language agents" — thus renders salient the relatively minor importance attributed to language in many conceptions of social action. Before attempting to imagine a new "social physics" in the age of AI, a far more important task for sociology is to address its fundamental linguistic deficit, which has often been exacerbated by the influence of individualistic theories of action and/or language.

Keywords: Large Language Models; Sociological Theory; Computational Social Science; Agent-Based Modeling; Linguistic Anthropology.

* M.Castelle.1@warwick.ac.uk

1 Introduction

Recent developments in natural language processing (NLP) — namely, artificial neural network-based large language models (LLMs) — appear to pose profound intellectual threats to many dominant late-20th-century conceptions of language, interpretation, and reasoning. Armed with untold training data and "fine-tuned" in a dialogical style, their widespread mainstream popularity has encouraged their deployment in many scholarly contexts across the social and computational sciences, which heretofore had been little interested in engaging with the complexity of natural language. This includes subfields at the intersection of social and computational science, such as agent-based modeling (ABM) and multi-agent systems (MAS), which have long been dominated by utilitarian, adversarial, and formal conceptions of social systems.

By contrast, the recent deployment of LLMs as "agents" in social simulations (Park et al., 2023; Vezhnevets et al., 2023) may unconsciously provide an existence proof for what some sociologists and anthropologists have long claimed — that language *is* social action (Silverstein, 2023). At the very least, their success and failures can help elucidate the currently controversial consonances and mismatches between LLMs and human actors. While contemporary attempts at LLM-based social simulation and/or the creation of AI agents are not always considered successful (Cemri et al., 2025), they have diagnostic value: they invite us to examine the capacity of sociological theory and computational social science (CSS) to explain why it is that they succeed or fail.

In this commentary, I will argue that computational social sciences and much social theory — by virtue of their long-term lack of engagement with language phenomena in previous decades — are not well-equipped to help elucidate these issues. To illustrate this, I will 1) examine the history of conceptions of language and action in sociological theory, STS, and linguistic anthropology; 2) illustrate the historical limits of computational agent simulations and of language-oriented content analysis in previous decades of computational social science; and 3) examine a recent LLM-based social simulation project in order to illustrate how it either problematizes or correlates with existing theoretical perspectives.

2 Language and Its Sociological Absences

Much as with technology, social theory and sociology in general have long had a somewhat awkward relationship with *language* and its relevance to social action. In the 19th century, when Comte was devising his foundational epistemology of society, he explicitly rejected the incorporation of a then-nascent "science of ideas" (known as *ideologie*) based on sensations, including the use of language and signs in general (Destutt de Tracy 1801; Comte, 1838, pp. 776–778). In turn, the major works of classical sociological theory, such as those by Marx, Weber, and Durkheim, pay little overt attention to the details of speech and/or writing phenomena.[1] By contrast, the Chicago School, in their ethnographies of neighborhoods and/or immigrants, took an explicit interest in speech and/or epistolary language use as a source of knowledge about society (Thomas & Znaniecki, 1918; Anderson, 1923; Whyte, 1943); yet even there, the fine interactional details of language practice were not the primary focus of attention. This was

1. Weber (1972 [1921-1922]) has much to say, of course, on "orders/commands" (*Befehle*) — and, in the case of bureaucracy, the importance of the "rules" (*Regeln*) and "the files" (*Akten*) — but not of their form nor content.

also the case for larger-scale studies of mass/broadcast/political communication (Lazarsfeld et al., 1944).

It was only in the 1960s, with the work of Erving Goffman and Harold Garfinkel, that the observational insights of the Chicago School were revealed as dependent on a fine-grained, everyday, reflexive, and savvy art of what might be called "sign-making" and/or "meaning-making".[2] For followers of Goffman (1959), all the world's a stage — which we know, at least, is full of *actors*, but is also redolent in *roles, routines, performances, settings, frontstage/backstage*, etc., i.e., a variety of techniques and technologies of communication and "impression management", all of which clearly depend on the intricacies of speech and/or sign-making in general. But while sociological approaches like symbolic interactionism and ethnomethodology (Garfinkel, 1967) privileged natural-language conversation as an empirical and analytic object, their ontological framing of language remained rather instrumental. For these traditions, the use of speech in interaction merited careful empirical attention, insofar as it offered insight into constitutive social dynamics which themselves were not conceived as fundamentally linguistic in nature: e.g., the coordination of interaction, negotiation of contingency, the management of indeterminate meaning, and the repair of social order (Garfinkel & Sacks, 1970).[3]

In sociology, the empirical focus on natural language-in-use entailed a restriction of the analytic frame to the face-to-face, or what is usually called "micro" social phenomena, enabled by the adoption of meticulous techniques of recording, note-taking, and annotation of everyday interaction (Sacks et al., 1974). Sociologists could have continued on this discourse-centric, interactional path, but outside of the Sacks-influenced subfield of conversation analysis, mostly did not. For many sociologists, the armchair-philosopher's pragmatics of Austin (1962) became the primary source for comprehending language-as-practical-action, and there seemed little more to say.[4]

The then-nascent field of computer science, on the other hand, would come to embrace Noam Chomsky's conception of language — which, as per its MIT origins, shared the computer scientists' own conceptual scaffolding of tree-like data structures and automata theory. This program in linguistics imagined the everyday linguistic "competence" of *parole* to be far less intriguing than the formalization of *langue* as combinatorial and algorithmic hierarchical data transformations, and as such was far removed from the close attention to language as it is used for practical action.

Given the obvious social and cultural impact of LLMs, then, we can ask which disciplines are better equipped to analyze this tripartite relationship between language, technology, and social action. From the late 1970s onwards, the sociology and anthropology of science and

2. To refer to "sign-making" and "meaning-making" is to adopt vocabulary developed within semiotics. The semiotic essentials of Peirce (1932, sec. 2.227–2.308) have long been largely ignored by mainstream sociology, in part due to Charles Morris' widely-read behaviorist simplifications of Peirce (Morris, 1938; Rochberg-Halton & McMurtrey, 1983); Dewey (1946) was quick to note some of Morris' grave interpretational errors, to little avail.

3. Another innovative focus of the era, the *ethnography of speaking* (Hymes, 1962), led into both the increasingly quantitative "variationist" subfield of *sociolinguistics* (Labov, 1972), as well as linguistic anthropology (discussed below).

4. For extensive critiques of speech-act theory see Silverstein (1979) and Silverstein (2023). Among those implicated in an unreflective allegiance to speech-act theory include Habermas (1979) and the subfield of Symbolic Interactionism, the latter of which — as per its name — never quite came to grips with iconicity nor indexicality (Bakker, 2023). Even Bourdieu (1991), who critiques speech-act theory and appears to focus on language-in-action, arguably sidesteps the grounding of language phenomena in semiotic processes (Hasan, 1998).

technology, initially in conversation with ethnomethodology (Lynch, 1982; Suchman, 1987) developed an impressive theoretical and empirical apparatus for engaging with the role of *indexicality* in interactional speech and communication originally discussed by Garfinkel & Sacks (1970). However, while inspired by language-centric approaches, STS scholars did not see language activity as constitutive of sociotechnical phenomena (except obliquely in the case of Latour, 1987). Meanwhile, linguistic anthropologists, who saw sign-making and language activity as central to all things sociocultural (Silverstein, 1976; Schieffelin et al., 1998) only occasionally attended to materiality and rarely noted the existence of computers or digital language technologies (Lamoureaux et al., 2025).

It may surprise the reader that today, as AI researchers struggle to explain and/or improve the apparent "cultural competency" (or lack thereof) of LLM text and speech technologies, the proceedings of top NLP conferences are increasingly likely to cite the latter linguistic-anthropological theories, as well as aforementioned work by Goffman and Sacks (e.g., Zhou et al., 2025; AlKhamissi et al., 2026; T.Y.S.S., 2026), whereas STS and contemporary sociological theory are essentially found missing. This raises the question: why do some computer scientists now appear to privilege an understanding of language-as-sociocultural-action grounded in an arcane semiotics they were not previously exposed to? To address this question, we must look at the long-running work in sociology on the relations between computational technology and agency, and that between computational technology and language. This work is mostly concentrated in the field of computational social science (CSS).

3 Agents and Language in Computational Social Science

Computational social science (CSS) comprises multiple areas with their own lengthy and oft-independent scientific trajectories, namely 1) social network analysis, 2) agent-based modeling / "social simulation", 3) content analysis / "text-mining"; and 4) the overt use of machine learning and now deep learning methods for social analysis (Cioffi-Revilla, 2010; Edelmann et al., 2020).[5] While contemporary LLM "agents" and/or simulations implicitly assert the primacy of natural language in social interaction, I will argue in this section that CSS' engagement with both agency *and* language phenomena has been deficient and leaves sociology ill-prepared for the present moment.

I will focus on two strands of CSS in this section; namely, the agent-based modeling (ABM) tradition (one of the oldest in CSS) and the content-analysis/text-mining tradition. ABM — as illustrated by Epstein & Axtell's (1996) *Growing Artificial Societies* — is characterized by an orientation towards (1) individual "actors", in (2) interaction with each other, following (3) "simple" algorithmic rules in, ideally, (4) a dynamic environment from which agents can potentially learn from their actions (Macy & Willer, 2002). Such an approach can indeed be seen as a form of "social physics", in the sense of a mechanical-reductionist conception of society and a preoccupation with recognizable patterns emerging from formal rules.

5. Despite varied attempts to synthesize this field (Lazer et al., 2009; Watts, 2013; Salganik, 2018), I would argue that what implicitly holds it together is instead an alliance to a specific genre of language: namely, the *programming languages* necessary for algorithmically manipulating non-tabular and/or processual data structures (in opposition to, i.e., the common tools of frequentist statistics such as SPSS/Stata, primarily intended to manipulate an inert and tabular world of ideally-i.i.d. observations/"rows" of variables). Computational social scientists, whatever their stripes, thus form a kind of implicit third "speech community" or "community of practice" (Eckert & McConnell-Ginet, 1992) as observably distant from qualitative sociologists as they are from conventional quantitative sociologists; said "speech" is deployed both among each other and to the computers themselves (Coleman, 2013).

Proponents of ABM readily admit to the charge of *methodological individualism* (see Epstein & Axtell, 1996, p. 16); they argue that "macrosocial patterns must be understood as the outcome of processes at the microsocial level" and that "what aggregates up from micro to macro are not attributes of individuals but consequential decisions" (Macy & Flache, 2009, p. 248). The former phrase uses the language of causal inference to allude to the idea of "emergence", a somewhat paradoxical concept which simultaneously celebrates both a reductionist modeling approach and the impossibility of predicting the outcome of said reductionist model's forward simulation/operation (Hodgson, 2000). The latter phrase reflects the grounding of ABM in microeconomics and/or game theory, a world in which all actions can be cast as *decisions* among some small, finite set of *choices* or *preferences*, selected in order to optimize some unidimensional value.

In agent-based modeling and its associated disciplinary perspectives, such as "analytic sociology" (Hedström & Bearman, 2009), discussions of language phenomena are, historically, extremely scarce. Agents might "cooperate", "defect", "switch neighborhood", "trade", "choose", etc., but I have yet to see them "speak", even metaphorically.[6] Where agents were said to have "languages" at all, it was not within sociological ABM research but within a somewhat parallel universe of *multi-agent systems* (MAS), associated with the computer science subfield of artificial intelligence. However, in the latter case, "agent communication languages" (Wooldridge & Jennings, 1995) were designed using only an explicit and specialized syntax, intended to allow agents to communicate with one another to help achieve their goals (Genesereth & Ketchpel, 1994), as opposed to a natural language interface with either man or machine.

Instead, what the ABM and MAS communities primarily had in common in their conception of the "agent" — along with the then-predominant AI textbook, Russell & Norvig (1995) — were certain default assumptions of economic rationality. They shared the idea that "action" was a matter of an individual evaluating a situation and selecting moves from a minimal/finite repertoire — a situation rather distinct, one should note, from the situation (familiar to all of us) of the unconscious and everyday generation of sentences that have never been uttered before. Put briefly, ABM's adoption of methodological individualism aligned it with economics, psychology, and indeed a pre-connectionist (i.e., symbol-centric) artificial intelligence, and not so much with sociologists averse to the mechanical reductionism of this genre of system modeling. But it also meant that diverse speech and language phenomena (indeed, tricky to reduce to a finite set of "decisions") were also inaccessible to it.

So, if the concept of language and/or sign-use as a fundamentally constitutive component of social action was typically downplayed in ABM, how did natural language phenomena feature at all in CSS? The answer is in the form of techniques like *topic modeling*, *text classification*, and *content/sentiment analysis* across the 2000s and 2010s. This attention was largely pragmatic and inspired by technical developments in natural language processing (NLP), such as the Latent Dirichlet Allocation (LDA) algorithm used by Blei & Lafferty (2007) to cluster documents into a fixed number of clusters associated with particular words. Instead of conceiving language use as a kind of action, computational sociologists emphasized how the profusion

6. The absence of language/speech in ABM can raise questions about whether ABM methods should have ever been considered "simulations" of human societies; in one of the earliest examples of a "computational" sociology, James Coleman (1961, p. 216) writes: "Perhaps simulation is the wrong word, for it suggests that the attempt is to mirror in detail the actual functioning of a social system. Instead, the aim is very different: it is to program into the computer certain theoretical processes, and then to see what kind of a behavior system they generate".

of "text" in digital societies could specifically be used as a way to render social and cultural phenomena measurable (Bail, 2014), without addressing in what theoretical way entextualized speech is held to affect society and culture.

The use of (multi-)hundred-dimensional word embeddings (Mikolov et al., 2013; Pennington et al., 2014), learned from textual co-occurrence of Google News articles and/or Wikipedia/Common Crawl, respectively, marked the first use of neural network-related techniques in CSS. This high-dimensional geometrization of an entire language's *vocabulary* — realized through an enumeration of hundreds of thousands of words or morpheme-like "subwords" — is an important shift. Its implementors — without reading Saussure (1916) — inadvertently realized a kind of rigid Saussurean structuralism in which word "meaning" (in isolation) is purely *relational*; i.e. each of the numerical 100-element *word2vec* embedding vectors are only meaningful with respect to the others.[7]

By 2019, the "language models" generating these vectors had advanced in (1) their numbers of layers, (2) size of training data, and (3) processual entanglement between co-occurring subwords/"tokens" (via so-called "attention" layers), making it possible to create high-dimensional representations of entire sentences and paragraphs (Vaswani et al., 2017; Devlin et al., 2019). While a handful of computational social scientists (Do et al., 2022) would soon realize the advances in machine "understanding" made possible by these new so-called *contextual embeddings*, their interest remained largely pragmatic (Boutyline & Arseniev-Koehler, 2025).[8] But the NLP field (and a gradually increasing proportion of contemporary society) would never be the same.

This sets the stage for the social-scientific awakening to contemporary deep learning in the early 2020s with the release of OpenAI's ChatGPT. Up until that moment, many sociologists had not paid serious attention to the rise of deep learning. Computational social scientists primarily saw text as valuable but as something necessarily "layers removed from the 'social games' that sociologists seek to illuminate" (Evans & Aceves, 2016, p. 22).[9] This did not cause any problems as long as conversational technologies in NLP research remained something of a disappointment (Luger & Sellen, 2016). However, in the fast-growing AI research community, increasingly larger language models had been shown to be impressively effective at next-token-generation tasks in a variety of written speech genres (Brown et al., 2020). With disregard for most pre-existing theories in traditional linguistics, these multi-hundred-billion-parameter models were being trained on (1) vast amounts of text representing dozens of languages simultaneously, accompanied by (2) millions of lines of programming-language code (Chen et al., 2021); and in an accidental nod to Harvey Sacks, they were subsequently fine-tuned on (3) tens of thousands of human-generated examples of dialogical interaction (Ouyang et al., 2022), and ultimately released as "ChatGPT" in November 2022.

It is this genre of dialogical language models which would subsequently become the foundation for today's "agentic" LLMs, either for the purposes of social simulation or in the everyday

7. This link to structuralism is explicitly noted in one of CSS' most enlightened endeavors using word embeddings (Kozlowski et al., 2019), which validated cultural oppositions (represented as vectors in high-dimensional space) via both pre-trained and manually trained embedding vectors. Kozlowski (2026) subsequently explains the understanding of LLMs as Saussurean structuralism for a sociological theory audience.

8. The linguistic anthropologist Kockelman (2024) proposes referring to co-occurring words in artifactual/written text as "co-text" to distinguish it from the more general term "context" — this is helpful for analyzing (otherwise rather disembodied and inert) LLMs.

9. Cointet & Parasie (2018), by contrast, point out that some CSS scholarship in France has explicitly considered textual utterances as social action, including Chateauraynaud (2014) and their own work (Parasie & Cointet, 2012).

business use of LLM technologies like Claude Code (Hitzig et al., 2026). In the following sections, I will offer some reflections on the implications of this heretofore unrealizable fusion of language, technology, and action for sociological theory.

4 On "Language Agents" in Social Simulation

The ABM work of previous decades assumed that the emergence of social behaviors would be a confluence of individuality, rules, and goals; simulations using LLM agents — exemplified by the "Generative Agents" paper of Park et al. (2023) — are a significantly different endeavor. In this latter work, dialogical models are used to create a virtual "community" of "agents" in a small video-game-like 2D world ("Smallville"), each of which are provided paragraph-length natural-language "seed memories" about their identity and unleashed atop a relatively lightweight "game engine".[10] These agents go about daily tasks, interact with each other, and pursue "goals", with the caveat that said goals and behaviors are described/generated/recorded in natural language and are not driven by rule-following or rewards in any overtly utilitarian sense.[11] This means that in Smallville, all actions are derived from and/or generated in natural-language form using the ChatGPT API.

Park et al. (2023) note that their use of LLMs in social simulation is explicitly inspired by the 2003 computer game *The Sims*, but a contrast between the two is instructive. *The Sims*' designer, Will Wright, was himself directly inspired by Maslow (1943) when encoding the denizens of his simulated town as bundles of "motives" ("hunger", "comfort", "hygiene," etc.), each represented internally as numerical values that decay over time. The result is a fundamentally utilitarian recreation of daily life in which "needs" are primitive and finite, and "actions" are a matter of equally-finite selection of nearby objects.[12] By contrast, a generative LLM — if it can be said to be making "decisions" at all — can only repeatedly select a next subword/token from the approximately 100,000 tokens in the model's vocabulary. It thus has an unthinkably vast "action space" which is a far cry from the Prisoner's Dilemma and the conventions of formal decision theory in general.

Might one call this new (and indeed radical) approach "language as social action"? Deciding this question would require us to perform a much closer inspection of LLM architectures and social simulation methodologies, in order to determine to what extent they align or do not align with existing theories of social action. One could, for example, attempt to draw a connection to the "relationism" of Abbott (2007), a proposal for alternative methods to causal and simulation models for sociological theory. While Abbott's "relationist" perspective agrees with simulation proponents like Hedström & Swedberg (1998) in "the basic assumption that acts are at the center of social analysis", it "problematizes the very notion of an entity capable

10. Later work on LLM-based agent simulations, such as that of Vezhnevets et al. (2023), even dispenses with the constrained 2D "sandbox" environment, through the use of an orchestrating (and also LLM-based) agent inspired by the "dungeon master" (DM) of tabletop role-playing games (Fine, 1985).

11. Interestingly, a footnote added to the final version of the paper (version 2 on arXiv) notes that "When referring to generative agents engaging in actions or going to places, this is a shorthand for readability and not a suggestion that they are engaging in human-like agency. The behaviors of our agents, akin to animated Disney characters, aim to create a sense of believability, but they do not imply genuine agency" (Park et al., 2023, p. 2); while there is much talk of "agents", this is the only occurrence of the word "agency" in the paper.

12. In the early 2000s, Wright was an occasional collaborator with Ken Forbus at Northwestern University (Forbus & Wright, 2001), which was also a center for ABM projects such as NetLogo (Tisue & Wilensky, 2004) and, later, a frequent host for CSS conferences.

of action (the notion of agent), *viewing entities as constant by-products of repeated action*" (Abbott, 2007, emphasis added). For Abbott, actions are "inherently open to redefinition — by later action, by actions of others, by the inherent multiplicity whereby many agents participate in the 'I' who acts". What better describes a social simulation in which the only possible action of each "agent" is the emission of single subwords as predicated on extended textual representations of past actions and utterances from itself and others?[13]

While the use of LLMs as individually "simulated" participants in survey and/or interview methods is currently highly controversial (Boelaert et al., 2025), the implications of explicitly interactional LLM-centric multi-agent social simulation have begun to reach computational social scientists, as in Kozlowski & Evans (2025). They tend to be rather polite with respect to the history of agent-based social simulation, suggesting that the previous rational-action/rule-based/choice-based approaches were used because "specifying realistic actors posed a daunting challenge" and/or to achieve "more interpretable and less fragile findings" (Kozlowski & Evans, 2025, p. 1024). They thus gloss over previous disciplinary hostility and/or aversion to the very idea that language use is constitutive of much of the social and cultural phenomena they purported to be studying. It is seemingly only with LLMs that methodologists can openly recognize that language *is* social action and, consequently, claim that they were interested in "culture" all along.

5 Conclusion: Towards a Sociology of and with LLMs

If there is an intellectual victor in the situation depicted above, it is the historian of science Hans-Jörg Rheinberger, who in 1997 wrote that "[i]t is my contention... that epistemic things — things embodying concepts — deserve as much attention as generations of historians have bestowed on disembodied ideas" (Rheinberger, 1997, p. 8).[14] Computational sociologists' cautious explorations of aforementioned high-dimensional, language-centric "agents" are implicitly redeeming long-suppressed social-theoretic perspectives of conversation analysis and linguistic anthropology, even in the face of various architectural flaws and mismatches with human actors. These flaws and mismatches include (1) their obvious lack of corporeal embodiment and (2) lack of ability to continually update their weight parameters with every interaction — an as-yet-unsurmounted research problem known as *continual learning*. Given the historically extensive (and now potentially futile) endeavors to model society via individualist rational action, and given the similarly extensive attempts (in e.g. content analysis) to treat language as decontextualized from interactional use, the implications of LLM-based agents should, in principle, provide sociologists with more than enough ammunition to continue a time-honored tradition in their discipline from its inception — namely, a critical engagement

13. The fact that all agents are paradoxically implemented by the same API endpoint (only varying in their character-describing "prompts") only makes Park et al. (2023)'s achievement more impressive, but they do note that the agents have a shared tendency to "feel overly formal", which they speculate is "a result of instruction tuning in the underlying models" (Park et al., 2023, p. 5).

14. For Rheinberger, "epistemic things" (*epistemiche Dinge*) and "technical objects" (*technische Dinge*) exist on a gradient and are processually transformed into each other in scientific practice (Rheinberger, 1997, p. 30); in our case, the computational linguists' notion of "language" as fundamentally based on word co-occurrence (epistemic thing), through experimentation, becomes a trained yet opaque LLM (technical object), which thus in turn becomes yet another site of interpretation and experiment (epistemic thing), this time not just by computer scientists, but by social scientists as well (many of whom only noticed language models once they were materially realized as compelling technical objects).

with the formalisms long deployed by economists and the other individualist sciences to advance claims regarding the social world (Comte, 1839).[15]

References

Abbott, A. (2007). Mechanisms and Relations. *Sociologica*, *1*(2). https://www.rivisteweb.it/doi/10.2383/24750

AlKhamissi, M., Xiao, Y., AlKhamissi, B., & Diab, M. (2026). Hire Your Anthropologist! Rethinking Culture Benchmarks through an Anthropological Lens. In V. Demberg, K. Inui, L. Marquez (Eds.), *Findings of the Association for Computational Linguistics: EACL 2026* (pp. 1218–1235). https://doi.org/10.18653/v1/2026.findings-eacl.63

Anderson, N. (1923). *The Hobo*. Chicago, IL: University of Chicago Press.

Austin, J.L. (1962). *How to Do Things with Words*. Oxford: Oxford University Press.

Bail, C.A. (2014). The Cultural Environment: Measuring Culture with Big Data. *Theory and Society*, *43*(3–4), 465–482. https://doi.org/10.1007/s11186-014-9216-5

Bakker, J.I. (2023). Blumer, Weber, Peirce, and the Big Tent of Semiotic Sociology: Notes on Interactionism, Interpretivism, and Semiotics. In A. Cossu & J. Fontdevila (Eds.), *Interpretive Sociology and the Semiotic Imagination* (pp. 52–73). Bristol, UK: Bristol University Press. https://doi.org/10.46692/9781529211764.004

Blei, D.M., & Lafferty, J.D. (2007). A Correlated Topic Model of Science. *The Annals of Applied Statistics*, *1*(1), 17–35. https://doi.org/10.1214/07-AOAS114

Boelaert, J., Coavoux, S., Ollion, É., Petev, I., & Präg, P. (2025). Machine Bias. How Do Generative Language Models Answer Opinion Polls? *Sociological Methods & Research*, *54*(3), 1156–1196. https://doi.org/10.1177/00491241251330582

Bourdieu, P. (1991). *Language and Symbolic Power: The Economy of Linguistic Exchanges*. London: Polity.

Boutyline, A., & Arseniev-Koehler, A. (2025). Meaning in Hyperspace: Word Embeddings as Tools for Cultural Measurement. *Annual Review of Sociology*, *51*, 89–107. https://doi.org/10.1146/annurev-soc-090324-024027

Brown, T.B., Mann, B., Ryder, N., Subbiah, M., Kaplan, J., Dhariwal, P., Neelakantan, A., Shyam, P., Sastry, G., Askell, A., Agarwal, S., Herbert-Voss, A., Krueger, G., Henighan, T., Child, R., Ramesh, A., Ziegler, D.M., Wu, J., Winter, C., Chen, M., Sigler, E., Litwin,

15. Before defending the admirable (and, lest we forget, ontologically social) philosophy of Adam Smith, Comte writes: "Inévitablement étrangers, par leur éducation, même envers les moindres phénomènes, à toute idée d'observation scientifique, à toute notion de loi naturelle, à tout sentiment de vraie démonstration, il est évident que, quelle que pût être la force intrinsèque de leur intelligence, [nos économistes] n'out pu tout-à-coup appliquer convenablement aux analyses les plus difficiles une méthode dont ils ne connaissaient nullement les plus simples applications, sans aucune autre préparation philosophique que quelques vagues et insuffisans préceptes de logique générale, incapables d'aucune efficacité réelle. Aussi l'ensemblé de leurs travaux manifeste-t-il évidemment, de prime abord, à tout juge compétent et exercé, les caractères les plus décisifs des conceptions purement métaphysiques" (Comte, 1839, pp. 266–267).

M., Gray, S. Chess, B., Clark, J., Berner, C., McCandlish, S., Radford, A., Sutskever, I., & Amodei, D. (2020). Language Models are Few-shot Learners. arXiv:2005.14165. https://doi.org/10.48550/arXiv.2005.14165

Cemri, M., Pan, M.Z., Yang, S., Agrawal, L.A., Chopra, B., Tiwari, R., Keutzer, K., Parameswaran, A., Klein, D., Ramchandran, K., Zaharia, M.A., Gonzalez, J., & Stoica, I. (2025). Why Do Multi-agent LLM Systems Fail? In D. Belgrave, C. Zhang, H. Lin, R. Pascanu, P. Koniusz, M. Ghassemi, & N. Chen (Eds.), *Advances in Neural Information Processing Systems* (Vol. 38). Red Hook, NY: Curran Associates, Inc. https://proceedings.neurips.cc/paper_files/paper/2025/file/b1041e52d3be19f0a9bc491657488e4a-Paper-Datasets_and_Benchmarks_Track.pdf

Chateauraynaud, F. (2014). Trajectoires argumentatives et constellations discursives: Exploration socio-informatique des futurs vus depuis le nanomonde. *Réseaux*, *188*(6), 121–158. https://doi.org/10.3917/res.188.0121

Chen, M., Tworek, J., Jun, H., Yuan, Q., Pinto, H.P. de O., Kaplan, J., Edwards, H., Burda, Y., Joseph, N., Brockman, G., Ray, A., Puri, R., Krueger, G., Petrov, M., Khlaaf, H., Sastry, G., Mishkin, P., Chan, B., Gray, S., Ryder, N., Pavlov, M., Power, A., Kaiser, L., Bavarian, M., Winter, C., Tillet, P., Petroski Such, F., Cummings, D., Plappert, M., Chantzis, F., Barnes, E., Herbert-Voss, A., Guss, W.H., Nichol, A., Paino, A., Tezak, N., Tang, J., Babuschkin, I., Balaji, S., Jain, S., Saunders, W., Hesse, C., Carr, A.N., Leike, J., Achiam, J., Misra, V., Morikawa, E., Radford, A., Knight, M., Brundage, M., Murati, M., Mayer, K., Welinder, P., McGrew, B., Amodei, D., McCandlish, S., Sutskever, I., & Zaremba, W. (2021). *Evaluating Large Language Models Trained on Code* (arXiv:2107.03374). arXiv. https://doi.org/10.48550/arXiv.2107.03374

Cioffi-Revilla, C. (2010). Computational Social Science. *Wiley Interdisciplinary Reviews: Computational Statistics*, *2*, 259–271. https://doi.org/10.1002/wics.95

Cointet, J.-P., & Parasie, S. (2018). Ce que le big data fait à l'analyse sociologique des textes:Un panorama critique des recherches contemporaines. *Revue française de sociologie*, *59*(3), 533–557. https://doi.org/10.3917/rfs.593.0533

Coleman, E.G. (2013). *Coding Freedom: The Ethics and Aesthetics of Hacking*. Princeton, NJ: Princeton University Press.

Coleman, J.S. (1961). Analysis of Social Structures and Simulation of Social Processes With Electronic Computers. *Educational and Psychological Measurement*, *21*(1), 203–218. https://doi.org/10.1177/001316446102100121

Comte, A. (1838). *Cours de philosophie positive. Tome 3, La philosophie chimique et la philosophie biologique*. Paris: Bachelier. https://hdl.handle.net/2027/ucm.5310742543

Comte, A. (1839). *Cours de philosophie positive. Tome 4, La partie dogmatique de la philosophie sociale*. Paris: Bachelier.

Destutt de Tracy, A.-L.-C. (1801). *Projet d'éléments d'idéologie*. Paris: P. Didot l'aîné. https://gallica.bnf.fr/ark:/12148/bpt6k10455061

Devlin, J., Chang, M.-W., Lee, K., & Toutanova, K. (2019). BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding. *Proceedings of the 2019 Conference of*

the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Volume 1 (Long and Short Papers), 4171–4186. https://doi.org/10.18653/v1/N19-1423

Dewey, J. (1946). Peirce's Theory of Linguistic Signs, Thought, and Meaning. *The Journal of Philosophy*, *43*(4), 85–95. https://doi.org/10.2307/2019493

Do, S., Ollion, É., & Shen, R. (2022). The Augmented Social Scientist: Using Sequential Transfer Learning to Annotate Millions of Texts with Human-Level Accuracy. *Sociological Methods & Research*, *53*(3), 1167–1200. https://doi.org/10.1177/00491241221134526

Eckert, P., & McConnell-Ginet, S. (1992). Think Practically and Look Locally: Language and Gender as Community-Based Practice. *Annual Review of Anthropology*, *21*(Volume 21, 1992), 461–488. https://doi.org/10.1146/annurev.an.21.100192.002333

Edelmann, A., Wolff, T., Montagne, D., & Bail, C.A. (2020). Computational Social Science and Sociology. *Annual Review of Sociology*, *46*, 61–81. https://doi.org/10.1146/annurev-soc-121919-054621

Epstein, J.M., & Axtell, R.L. (1996). *Growing Artificial Societies: Social Science from the Bottom Up*. Washington, DC: Brookings Institution Press.

Evans, J.A., & Aceves, P. (2016). Machine Translation: Mining Text for Social Theory. *Annual Review of Sociology*, *42*(1), 21–50. https://doi.org/10.1146/annurev-soc-081715-074206

Fine, G.A. (1985). *Shared Fantasy. Role-Playing Games as Social Worlds*. Chicago, IL: University of Chicago Press.

Forbus, K.D., & Wright, W. (2001). *Some Notes on Programming Objects in The Sims.* https://www.qrg.northwestern.edu/papers/Files/Programming_Objects_in_The_Sims.pdf

Garfinkel, H. (1967). *Studies in Ethnomethodology*. Englewood Cliffs, NJ: Prentice-Hall.

Garfinkel, H., & Sacks, H. (1970). On Formal Structures of Practical Actions. In J. McKinney & E.A. Tiryakian (Eds.), *Theoretical Sociology: Perspectives and Developments* (pp. 337–366). New York, NY: Appleton-Century-Crofts.

Genesereth, M.R., & Ketchpel, S.P. (1994). Software Agents. *Communications of the ACM*, *37*(7), 48–53. https://doi.org/10.1145/176789.176794

Goffman, E. (1959). *The Presentation of Self in Everyday Life*. Garden City, NY: Doubleday Anchor Books.

Habermas, J. (1979). *Communication and the Evolution of Society* (T. McCarthy, Trans.). Boston, MA: Beacon Press.

Hasan, R. (1998). The Disempowerment Game: Bourdieu and Language in Literacy. *Linguistics and Education*, *10*(1), 25–87. https://doi.org/10.1016/S0898-5898(99)80104-1

Hedström, P., & Bearman, P. (Eds.). (2009). *The Oxford Handbook of Analytical Sociology*. Oxford: Oxford University Press.

Hedström, P., & Swedberg, R. (1998). *Social Mechanisms: An Analytical Approach to Social Theory*. Cambridge: Cambridge University Press.

Hitzig, Z., Massenkoff, M., Lyubich, E., Zhang, S., Heller, R., & McCrory, P. (2026). *Agentic Coding and Persistent Returns to Expertise*. https://www.anthropic.com/research/claude-code-expertise

Hodgson, G.M. (2000). The Concept of Emergence in Social Sciences: Its History and Importance. *Emergence*, *2*(4), 65–77. https://doi.org/10.1207/S15327000EM0204_08

Hymes, D. (1962). The Ethnography of Speaking. *Anthropology and Human Behavior*, *13*(53), 13–53.

Kockelman, P. (2024). *Last Words: Large Language Models and the AI Apocalypse*. Chicago, IL: Prickly Paradigm Press.

Kozlowski, A.C. (2026). Computational Structuralism: Toward a Formal Theory of Meaning in the Age of Digital Intelligence. *Theory and Society*, *55*(2), 35. https://doi.org/10.1007/s11186-026-09685-z

Kozlowski, A.C., & Evans, J. (2025). Simulating Subjects: The Promise and Peril of Artificial Intelligence Stand-Ins for Social Agents and Interactions. *Sociological Methods & Research*, *54*(3), 1017–1073. https://doi.org/10.1177/00491241251337316

Kozlowski, A.C., Taddy, M., & Evans, J.A. (2019). The Geometry of Culture: Analyzing the Meanings of Class through Word Embeddings. *American Sociological Review*, *84*(5), 905–949. https://doi.org/10.1177/0003122419877135

Labov, W. (1972). *Sociolinguistic Patterns*. Philadelphia, PA: University of Pennsylvania Press.

Lamoureaux, S., Castelle, M., & Weichselbraun, A. (2025). Language Machines: Toward a Linguistic Anthropology of Large Language Models. *Journal of Linguistic Anthropology*, *36*(1). https://doi.org/10.1111/jola.70033

Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press.

Lazarsfeld, P.F., Berelson, B., & Gaudet, H. (1944). *The People's Choice. How the Voter Makes up his Mind in a Presidential Campaign*. New York, NY: Duell, Sloan & Pearce.

Lazer, D., Pentland, A., Adamic, L., Aral, S., Barabási, A.-L., Brewer, D., Christakis, N., Contractor, N., Fowler, J., Gutmann, M., Jebara, T., King, G., Macy, M., Roy, D., & Van Alstyne, M. (2009). Computational Social Science. *Science*, *323*(5915), 721–723. https://doi.org/10.1126/science.1167742

Luger, E., & Sellen, A. (2016). "Like Having a Really Bad PA": The Gulf between User Expectation and Experience of Conversational Agents. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems,* 5286–5297. https://doi.org/10.1145/2858036.2858288

Lynch, M.E. (1982). Technical Work and Critical Inquiry: Investigations in a Scientific Laboratory. *Social Studies of Science*, *12*(4), 499–533. https://doi.org/10.1177/030631282012004002

Macy, M., & Flache, A. (2009). Social Dynamics from the Bottom Up: Agent-Based Models of Social Interaction. In P. Bearman & P. Hedström (Eds.), *The Oxford Handbook of Analytical*

Sociology (pp. 245–268). Oxford: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199215362.013.11

Macy, M., & Willer, R. (2002). From Factors to Actors: Computational Sociology and Agent-Based Modeling. *Annual Review of Sociology*, *28*, 143–166. https://doi.org/10.1146/annurev.soc.28.110601.141117

Maslow, A.H. (1943). A Theory of Human Motivation. *Psychological Review*, *50*(4), 370–396. https://doi.org/10.1037/h0054346

Mikolov, T., Sutskever, I., Chen, K., Corrado, G., & Dean, J. (2013). Distributed Representations of Words and Phrases and Their Compositionality. *Proceedings of the 26th International Conference on Neural Information Processing Systems – Volume 2*, 3111–3119. https://doi.org/10.48550/arXiv.1310.4546

Morris, C.W. (1938). Foundations of the Theory of Signs. In O. Neurath, R. Carnap, & C.W. Morris (Eds.), *International Encyclopedia of Unified Science*, *1*(2), 1–59. Chicago, IL: University of Chicago Press.

Ouyang, L., Wu, J., Jiang, X., Almeida, D., Wainwright, C.L., Mishkin, P., Zhang, C., Agarwal, S., Slama, K., Ray, A., Schulman, J., Hilton, J., Kelton, F., Miller, L., Simens, M., Askell, A., Welinder, P., Christiano, P., Leike, J., & Lowe, R. (2022). *Training Language Models to Follow Instructions with Human Feedback*. arXiv:2203.02155. https://doi.org/10.48550/arXiv.2203.02155

Parasie, S., & Cointet, J.-P. (2012). La presse en ligne au service de la démocratie locale:Une analyse morphologique de forums politiques. *Revue française de science politique*, *62*(1), 45–70. https://doi.org/10.3917/rfsp.621.0045

Park, J.S., O'Brien, J.C., Cai, C. J., Morris, M.R., Liang, P., & Bernstein, M.S. (2023). *Generative Agents: Interactive Simulacra of Human Behavior*. arXiv:2304.03442. https://doi.org/10.48550/arXiv.2304.03442

Peirce, C.S. (1932). C*ollected papers of Charles Sanders Peirce: Vol. 2. Elements of Logic* (C. Hartshorne & P. Weiss, Eds.). Cambridge, MA: Harvard University Press.

Pennington, J., Socher, R., & Manning, C. (2014). GloVe: Global Vectors for Word Representation. In A. Moschitti, B. Pang, & W. Daelemans (Eds.), *Proceedings of the 2014 Conference on Empirical Methods in Natural Language Processing (EMNLP)* (pp. 1532–1543). Stroudsburg, PA: Association for Computational Linguistics. https://doi.org/10.3115/v1/D14-1162

Rheinberger, H.-J. (1997). *Toward a History of Epistemic Things: Synthesizing Proteins in the Test Tube*. Stanford, CA: Stanford University Press.

Rochberg-Halton, E., & McMurtrey, K. (1983). The Foundations of Modern Semiotic: Charles Peirce and Charles Morris. *American Journal of Semiotics*, *2*(1/2), 129–156. https://doi.org/10.5840/ajs198321/211

Russell, S. J., & Norvig, P. (1995). *Artificial Intelligence: A Modern Approach*. Englewood Cliffs, NJ: Prentice Hall.

Sacks, H., Schegloff, E.A., & Jefferson, G. (1974). A Simplest Systematics for the Organization of Turn-Taking for Conversation. *Language*, *50*(4), 696–735. https://doi.org/10.2307/412243

Salganik, M.J. (2018). *Bit by Bit: Social Research in the Digital Age*. Princeton, NJ: Princeton University Press.

Saussure, F. de. (1916). *Cours de linguistique générale* (C. Bally & A. Sechehaye, Eds.). Lausanne: Payot.

Schieffelin, B.B., Woolard, K.A., & Kroskrity, P.V. (1998). *Language Ideologies: Practice and Theory*. Oxford: Oxford University Press.

Silverstein, M. (1976). Shifters, Linguistic Categories and Cultural Description. In K.H. Basso & H.A. Selby (Eds.), *Meaning in Anthropology* (pp. 11–55). Albuquerque, NM: University of New Mexico Press.

Silverstein, M. (1979). Language Structure and Linguistic Ideology. In P.R. Clyne, W.F. Hanks, & C.L. Hofbauer (Eds.), *The Elements: A Parasession on Linguistic Units and Levels* (pp. 193–247). Chicago, IL: Chicago Linguistic Society.

Silverstein, M. (2023). *Language in Culture: Lectures on the Social Semiotics of Language*. Cambridge: Cambridge University Press.

Suchman, L.A. (1987). *Plans and Situated Actions: The Problem of Human-Machine Communication*. Cambridge: Cambridge University Press.

Thomas, W.I., & Znaniecki, F. (1918). *The Polish Peasant in Europe and America: Monograph of an Immigrant Group*. Boston, MA: Richard G. Badger.

Tisue, S., & Wilensky, U. (2004). NetLogo: A Simple Environment for Modeling Complexity. In *Proceedings of the International Conference on Complex Systems* (pp. 16–21). Boston, MA.

T.Y.S.S., S. (2026). From Naturalness to Norms: Interactional Cultural Competence for SpeechLMs. In M. Liakata, V.P. Moreira, J. Zhang, & D. Jurgens (Eds.), *Proceedings of the 64th Annual Meeting of the Association for Computational Linguistics* (Volume 1: Long Papers) (pp. 31787–31802). Stroudsburg, PA: Association for Computational Linguistics. https://doi.org/10.18653/v1/2026.acl-long.1466

Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A.N., Kaiser, L., & Polosukhin, I. (2017). *Attention Is All You Need*. arXiv:1706.03762. https://arxiv.org/abs/1706.03762v5

Vezhnevets, A.S., Agapiou, J.P., Aharon, A., Ziv, R., Matyas, J., Duéñez-Guzmán, E.A., Cunningham, W.A., Osindero, S., Karmon, D., & Leibo, J.Z. (2023). *Generative Agent-Based Modeling with Actions Grounded in Physical, Social, or Digital Space Using Concordia*. arXiv:2312.03664. https://doi.org/10.48550/arXiv.2312.03664

Watts, D.J. (2013). Computational Social Science: Exciting Progress and Future Directions. *The Bridge on Frontiers of Engineering*, *43*(4), 5–10. https://doi.org/10.1145/2939672.2945366

Weber, M. (1972). *Wirtschaft und Gesellschaft: Grundriss der verstehenden Soziologie* (J. Winckelmann, Ed., 5th ed.). Tübingen, Germany: Mohr Siebeck.

Whyte, W.F. (1943). *Street Corner Society: The Social Structure of an Italian Slum*. Chicago, IL: University of Chicago Press.

Wooldridge, M., & Jennings, N.R. (1995). Intelligent Agents: Theory and Practice. *The Knowledge Engineering Review*, *10*(2), 115–152. https://doi.org/10.1017/S0269888900008122

Zhou, N., Bamman, D., & Bleaman, I.L. (2025). Culture Is Not Trivia: Sociocultural Theory for Cultural NLP. In W. Che, J. Nabende, E. Shutova, & M.T. Pilehvar (Eds.), *Proceedings of the 63rd Annual Meeting of the Association for Computational Linguistics* (Volume 1: Long Papers) (pp. 25869–25886). Stroudsburg, PA: Association for Computational Linguistics. https://doi.org/10.18653/v1/2025.acl-long.1256

Michael Castelle – Centre for Interdisciplinary Methodologies (CIM), University of Warwick (United Kingdom)
https://orcid.org/0000-0001-6754-6516 | M.Castelle.1@warwick.ac.uk
https://castelle.org/
Michael Castelle is Associate Professor at the Centre of Interdisciplinary Methodologies at the University of Warwick (UK). His research is at the intersection of science and technology studies, history of computing, and linguistic anthropology. He is interested in the use of sociological, anthropological, historical, and semiotic perspectives in recontextualizing and understanding contemporary technological practices, from databases and distributed systems to machine learning and artificial intelligence.