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Rethinking Scientific Habitus: Toward a Theory of Embodiment, Institutions, and Stratification of Science

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Abstract
Pierre Bourdieu's concept of habitus has been largely absent in Science and Technology Studies (STS) despite its potential usefulness. In this essay, I develop the concept of scientific habitus as a useful way to think about scientific practices. I argue that scientific habitus may offer three contributions that illuminate scientists' own micro-practices in relation to meso- and macro-level dynamics in the scientific field. First, the concept enables us to think of scientists' worldviews and bodily techniques as objects of STS analysis. While the majority of STS scholars have focused on the construction of knowledge, scientific habitus allows us to study the construction of the scientists' body and mind. Secondly, scientific habitus links individual practices with institutional contexts; it highlights how the micro-practices of individuals in scientific laboratories reflect and reproduce macro-social structural power dynamics. Third, scientific habitus reveals mechanisms of stratification within the scientific field. It helps unpack scientists' practical decisions surrounding research topics, ideas, and data. It also helps explain why and how certain scientific projects are preferred and others left undone. Scientific habitus, therefore, has the potential to contribute to a more encompassing explanation of the relationship between societal structures and the internal logic of the scientific field.

Keywords
habitus; ethnography; embodiment; institutions; stratification

Scientific Habitus: An Obsolete Concept?
Over the past decades, STS scholars have sought to understand science as practice and culture rather than as abstract knowledge. Numerous ethnographic studies of science laboratories have documented how scientific discoveries are achieved in relation to institutional, symbolic, and interactional contexts (Fujimura 1996; Garfinkel, Lynch, and Livingston 1981; Gilbert and Mulkay 1984; Kleinman 2003; Knorr-Cetina 1999; Lynch 1997; Latour and Woolgar 1986; Traweek 1988).

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Although some scholars have mentioned the potential usefulness of Bourdieusian field theory (Albert and Kleinman 2011; Baker 2017; Camic 2011; Gauchat 2011; Gauchat and Andrews 2018; Hess 2011; Panofsky 2011), STS scholars, in general, have not used Bourdieu's concept of habitus as an analytical tool in the study of science. I explore how habitus can be used in STS to more fully exploit the theoretical and empirical possibilities of Bourdieu.

With the theoretical triad of *field, capital, and habitus*, Bourdieu outlined how social agents' internal practices and positions of power produce and reproduce social inequalities (Bourdieu 1977, 1990, 2000; Bourdieu and Wacquant 1992; Swartz 1997). In essence, actors attain capital in a specific field (e.g. money in economic field, political authority in political field, or cultural capital in artistic field), and behave based on their set of internalized dispositions (habitus), which have been shaped by their institutional context and experience (Bourdieu 1984, 101). Habitus, according to Bourdieu, (1) operates beneath the level of consciousness, (2) varies by social location and trajectory, (3) results from education and training, and (4) is a set of acquired and malleable dispositions. This Bourdieusian explanation of social practices reveals how subjective dispositions and definitions of situations shape, and are shaped by, objective societal structures; it connects sub-conscious social psychological phenomena of individuals and objectively existing social structures. As relatively durable mental and bodily dispositions, habitus makes up a person's perceptions and actions; it triggers one's routinized, almost unthinking, behaviors that further propagate not only the existing rules of the field, but also one's relative position within it (Wacquant 2011).[2]

In this essay, I develop Bourdieu's concept of scientific habitus. Although Bourdieu wrote extensively about scientific habitus (Bourdieu 1988, 1975, 2004a; Bourdieu, Chamboredon, and Passeron 1991), he did not (1) articulate a clear distinction between general scholastic habitus and scientific habitus, (2) separate social and natural sciences, or (3) conduct any empirical studies on natural science.[3] By drawing on my ethnographic data from university-based science laboratories as well as careful analysis of secondary sources, I argue that scientific habitus illuminates how micro-practices of scientists (e.g. tacit knowledge and definitions of situations) are intertwined within a meso-level institutional matrix (e.g. universities, disciplines, and laboratories) and further with macro-level patterns of stratification within the scientific field (e.g. formation of undone sciences). Scientific habitus explains how scientists who are trained under certain institutional contexts become participants in the stratified structure of the scientific field.

[2] Bourdieu illustrated the accumulation and exercise of social group habitus with numerous empirical cases, including Algerian peasants' economic dispositions during the capitalistic reform by French colonists (Bourdieu 1979), French academic intellectuals' synchronized habitus with laborers during the May 1968 events in France (Bourdieu 1988), Old "unmarriageable" bachelors in rural France (Bourdieu 2004b, 2008), and a class-specific cultural taste that reproduces class stratification (Bourdieu 1987, 1984).

[3] For limitations of Bourdieu's analysis on the scientific field, see Camic (2011, 2013), Gieryn (2006), Gingras (2006), and Sismondo (2011).

Embodiment, Institutions, and Stratification

One of the premises of habitus is that individuals' taken-for-granted world views and ways of moving their bodies are intertwined with their social and historical backgrounds. Social agents' bodily techniques and definitions of situations are not only a consequence of structures, but also a mechanism of reproducing the status quo. In this context, scientific habitus provides a comprehensive analytic lens that encompasses a variety of experiences from micro-bodily techniques of scientists to macro-social structures that govern how the scientific community works. How scientists do their daily jobs is inseparable from their institutional environment and the process through which the stratified structure of the scientific field is reproduced (Figure 1).

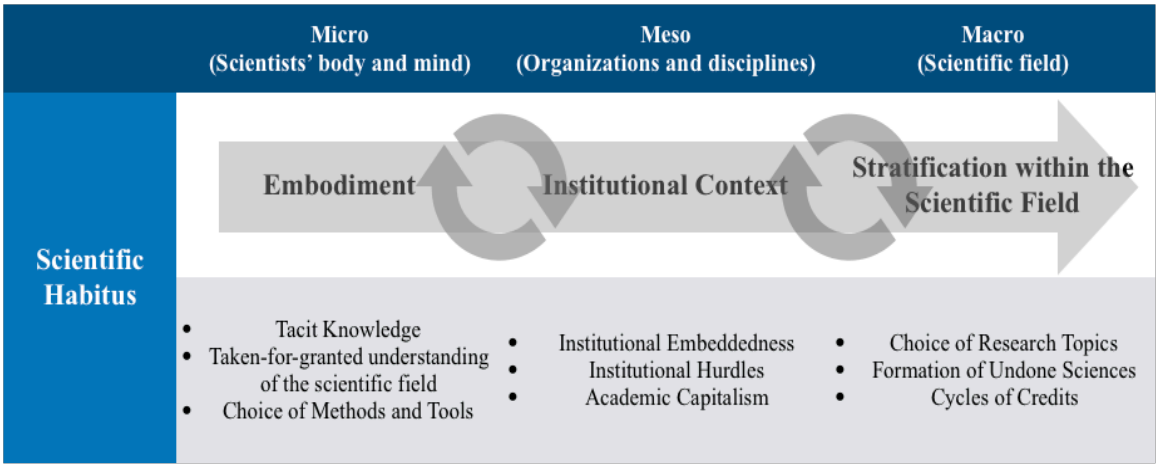

Figure 1. Micro, Meso, and Macro Dynamics of Scientific Habitus

Scientific habitus encompasses bodily, institutional, and macro-social dimensions of scientific practices. First, scientific habitus enables us to see scientists' bodily techniques and worldview as an object of STS analysis. It invites STS to focus not only on the construction of knowledge, but also on the construction of scientists' body and mind—an embodiment of physical and mental states. In scientific laboratories, for instance, scientists perceive their work not only as a mental labor, but also as a manual labor. "Science is a manual labor. That's what I learned in my grad school," one post-doc researcher in a lab told me. Their ordinary work-time is a repetition of disciplined bodily movements—grasping an Eppendorf pipet, carrying 2 ul of sample to 48 test tubes, reading and deciphering DNA strand sequence on a computer screen. During scientific experiments scientists engage with material infrastructures using embodied techniques that are repeated, internalized, and routinized over time. Tools of the experiment (machines and apparatus) do not dictate the mode of production of scientific data by themselves; instead, the construction of legitimate data is a bodily process that involves human agency (Clarke and Fujimura 1992; Latour and Woolgar 1986; Garfinkel, Lynch, and Livingston 1981; Jordan and Lynch 1998). Such body work is a combination of choreographed postures and disciplined sensory skills. They are often inexplicable, yet still essential components of scientific

practices (Polanyi 1958; Collins 1974, 2010). Harry Collins uses the term *somatic* tacit knowledge: the embodied form of tacit knowledge that describes a "skilled touch typist—that is, someone who does not look at the keyboard as they type" (Collins 2010, 103). Tacit knowledge includes inexplicable sensory, thus bodily, intuition that scientists rely on when they separate legitimate data from background noise (Star 1983; Garfinkel, Lynch, and Livingston 1981; Jordan and Lynch 1992). In my fieldwork, scientists used *Lasergene pro* software to read, adjust, and confirm the DNA sequence. Among peaks of signals, scientists "just knew" how to differentiate noise peaks from "real" signals. Bourdieu echoes this connection between tacit knowledge and habitus. He writes, "to be able to use a tool, and to do it 'comfortably' (…) one has to have 'grown into it' through long use (…) inscribed in it as a tacit 'manual' (…) instrumentalized by the instrument (Bourdieu 2000, 143)."

Embodiment of scientific habitus may also reflect scientists' taken-for-granted understanding of the scientific field. In other words, it denotes scientists' embodied mode of playing the game of science. Brubaker argues that scientific habitus "determines the kinds of problems that are posed," and "the kinds of instruments—conceptual, methodological, statistical—that are employed" (Brubaker 1993, 213). In my fieldwork, the weekly laboratory meeting was an emblematic social space for this. Post-docs and graduate students shared a tacit understanding that their Principle Investigator (PI) had a preference for hearing not only their research progress and findings, but also how these findings would contribute to the lab's publishable manuscripts. One day, an hour before the lab meeting, a post-doc was debating what to present in the lab meeting—his new experimental data from a new PCR versus his new computer program that helps to identify how certain DNA sequence patterns are related to the enzyme's reactivity with cellulose materials. He consulted fellow post-docs and decided to present his programming result because he thought that it contained a more publishable story that would not only satisfy his PI, but also clarify the goals and direction of a manuscript to which many lab members were contributing. Although this decision-making process was not described at the meeting, he was clearly choosing his scientific method to meet the expectation that the lab meeting has to contribute to the lab's publications. He was playing the game of science (along with his colleagues and PI) with his particular choices about what to share with his team[4]. As such, and as Bourdieusian studies of other various social actors utilize habitus as a conceptual core to bind a group's wide range of dispositions (Holmes 2013; Desmond 2008; Wacquant 1995; Mears 2015), scientific habitus may encompass the scientist's set of bodily and mental dispositions that shape their disciplined actions at the work place, style of scientific inference, preferences in data selection, methodological orientations, and an understanding of the scientific field and themselves.

[4] STS scholars have reported various empirical examples of taken-for-granted assumptions that are shared among scientists, constructed via shared institutional contexts. Informed throughout their career trajectory, scientists (mis)understand their workplace as distanced from the political and economic influences (Kleinman 2003, 1998). Scientists often perceive laboratories as a field of competition for patents and publications (Hackett 1990; Kleinman and Vallas 2001; Etzkowitz 2003). The impact of the research is often quantified and situated, and it becomes a constitutive component of an identity of scientists (Hammarfelt, Rijcke, and Rushforth 2016; Kaltenbrunner 2018; Rushforth and de Rijcke 2015).

Secondly, scientific habitus links individualized practices to institutional contexts; it highlights how the micro practices of individuals in meso-level scientific institutions reflect and reproduce macro structures. Individuals within the same institution acquire a habitus that reflects the institution's norms, rules, and logics (Emirbayer and Johnson 2008; Vaughan 2008). For individuals with a shared habitus, "habitus is the basis of an implicit collusion among all the agents who are products of similar conditions and conditionings, and also of a practical experience of the transcendence of the group, of its ways of being and doing" (Bourdieu 2000, 145). Related to embodiment, institutions provide the context as to how scientists embody certain bodily and mental dispositions through their organization. STS scholars have highlighted the institutional face of natural scientific practices through various related concepts such as academic capitalism (Slaughter and Rhoades 2004), asymmetric convergence (Kleinman and Vallas 2001; Vallas and Kleinman 2007), triple-helix (Etzkowitz and Leydesdorff 2000; Etzkowitz 2008; Shinn 2002), and mode theory (Gibbons 1994, 2000). These scholars see academic science as "an organized activity shaped by general organizational forces" (Hackett 1990, 242). In my fieldwork, I met Joyce who had spent more than ten years as a post-doc. She earned her Ph.D. in horticulture and joined a biochemistry project as a post-doc in early 2001. Soon, she found that the project was not well aligned with her academic interests and, therefore, decided to leave the job. She now describes this as the most regretful moment in her entire career. After staying home to raise her children for 7 years, she tried again to find an academic job; however, she had no choice but to accept another low-paid post-doc position (which she described as a "demotion"). Now, with more than 10 years of experience as a post-doc in a competitive field, she asserts that scientific professionalism is all about being a versatile researcher who is able to research in accordance with funding opportunities. With much experience in this mostly powerless position as a post-doc in scientific institutions where funding determines the fate of scientists, Joyce has been institutionalized to be opportunistic. Her daily practices were organized around the condition of the scientific field that is highly dependent upon funding agencies' resources. Like so, scientific habitus makes sense of how scientific institution's characteristics nurture a particular routinized mindset of scientists who are embedded within it[5].

Institutional hurdles—such as scientists' research presentations at lab meetings, acquisition of techniques to work with mechanical tools, grant applications, examinations, and academic articles and patents—become a constitutive part of the scientists' self-identity and embodied mode of practices to behave like a "fish in water," as if one is a born-to-be scientist in the scientific field (Bourdieu and Wacquant 1992, 127). Through these "rites of institution" (Bourdieu 1991) one becomes a "professional" scientist to their intended audiences, peer groups, and systems of evaluation. Difficulties during the process become an entrance token to the field

[5] Other empirical examples that highlight scientific practices as institutionally shaped organized activity include works on scientists' managerial techniques to build a coherent institutional foci that coagulates scientists with different backgrounds and expertise in the interdisciplinary research governance (Rushforth, Franssen, and de Rijcke 2018; Panofsky 2011), and various network analyses of how institutional positionality within the network of a scientific community often shapes how scientists craft arguments, strategize publications, succeed in their field, and even define the meaning of ingenuity (Burt 2004; Foster, Rzhetsky, and Evans 2015; Shwed and Bearman 2010).

of contestation (Bourdieu 1993, 2004a). In the science lab where I conducted my fieldwork, scientists constantly experienced various institutional disciplinary practices. PIs were under the pressure of grant application strategies. Multiple times per week, I heard post-docs worry about the number of publications they could "produce" per year; graduate students often sought my advice about whether to continue their academic career, given the field of endless competitions and burdens of proof. It seems that "suffering" was part of the game. I observed that scientists constructed a colleagueship around it, justified such stress as necessary, criticized those who failed to pass it, and formulated a shared understanding of good scientific practice. In so doing, they attained some aspects of scientific habitus, and thus maintained "rites" and institutional logics that justify their work and that they in turn work to justify. Scientific habitus is, therefore, a useful concept to explain how scientists share, accept, and maintain institutionalized practices.

Third, scientific habitus reveals the relational mechanism of stratification within the scientific field. It allows us to understand how scientists are stratified within the scientific field by their own voluntary, though institutionally shaped, choices. Bourdieu argued that societal stratification is reproduced via social actors' practice of classifying each person and entity in a system of hierarchical stratification (Bourdieu 1984, 1987). Similarly, mediated by the institutional context, scientists make various choices regarding their research topics, methodologies, and goals. Through these choices, they are destined to be placed in a particular position within the scientific field, where resources are unevenly distributed. This seemingly autonomous and meritocratic, but deeply structured, process reproduces the pre-existing power dynamics within the field by scientists' participation in the distinctions that maintain the stratified status-quo. In my fieldwork, one large-scale funding project from the Department of Energy was up for renewal. However, the director of this project made a unilateral decision to change parts of the funding proposal, replacing a small group of field ecologists with soil ecologists who were more oriented toward "field-to-product" issues. This change occurred not merely because the soil ecologists were more productive, but because the soil ecologists were more adaptive to the Trump administration's environmental science funding priorities, whereas the field ecologists thought such a process to be politically and scientifically problematic. The director did not even consult the field ecologists for the proposal—instead, the soil ecologists became a new puzzle piece of the new proposal that satisfied the Trump administration's funding priority. Similarly, I interviewed some post-docs who had left academia to pursue industry jobs because they were tired of having to change and reframe their research in order to attract funding—they found this reframing to be hypocritical or dishonest. However, many scientists who remain in academia see no problem with reframing projects for the sake of funding. Each scientist makes their own choice in accordance with their *mode of playing the game of science*—scientific habitus. As a result, they wind up in different positions within the stratified scientific field—some are more funded than others, some continue their career, and some quit the field.

As such, scientific habitus helps scholars to understand how scientists navigate the terrain of the scientific field that is stratified by political and economic structures. For instance, STS scholars have identified the gap, an *undone science*, between institutionalized scientific outcomes and civil society's needs (Frickel et al. 2010; Hess 2015, 2016). This gap is primarily

derived from the unequal distribution of resources within the scientific field (e.g. lack of funding sources for environmental health research); however, according to the concept of scientific habitus, it is also maintained by scientists' voluntary and often unconscious choices to align themselves with particular scientific programs. Scientists find "important" and "interesting" problems by aligning experimental, organizational, and social do-abilities with ready-made theory-method packages, which establish the "hegemony" in leading scientists to choose particular pathways in their research program (Fujimura 1987, 1988, 1992). Scientists who choose to work with the civil society, rather than for their mainstream academic community, tend to publish in non-peer-reviewed journals that are less impactful and less useful for their academic careers (Hess 2009). Scientists who have not cumulated enough authority in the community reproduce "unsurprising" normal science, whereas scientists who occupy the highest stratum of the scientific field daringly conduct "gamble-like" projects that further escalate their credit in the field (Foster, Rzhetsky, and Evans 2015). Scientific habitus is useful to connect scientists' choices, not only with institutional and structural backgrounds, but also with the macro-scale consequences of such choices, which would be further reproduced by very participants of the field.

Conclusion

Scientific habitus is a useful concept for STS. It enables researchers to articulate connections among scientists' embodied practices, institutionalized training processes that occur within capitalistic academic structures, and stratified productions of scientific knowledge. Moreover, scientific habitus explains why and how pre-existing power structures within the scientific field are reproduced by the institutional logic that is largely hidden to external observers. STS scholars tend to use *either* microscopic *or* macroscopic theories, not both, to analyze scientific practices. Bourdieu's concept provides STS scholars the opportunity to understand macro-social contexts in relation to micro-social settings, and vice versa.

STS scholars should incorporate Bourdieu's theory of scientific habitus in their investigations. There are specific issues and challenges in studying scientific habitus worth noting. First, habitus can provide a useful tool for investigating variation in disciplines, institutions, and geographic locations. Scholars have reported different epistemic cultures and work environments in different scientific communities (Knorr-Cetina 1999; Nelson 2013; Suryanarayanan and Kleinman 2016; Traweek 1988). Future studies might further elaborate on such variation. Albert and his colleagues' research on the epistemic habitus of social scientists and medical scientists exemplifies the benefit and utility of studying various forms of scientific habitus (Albert, Paradis, and Kuper 2015; Albert and Laberge 2017; Albert and Paradis 2014). They found that social scientists who work in an interdisciplinary organizational setting with medical scientists often find that their understandings of scientific excellence, work process, and productivity were different from that of medical scientists. Due to this gap—despite the formal organizational premises for interdisciplinary collaboration, the internal tension maintained among different scholars with distinctive epistemic habitus—some social scientists chose to

compromise their analytical rigor to collaborate with medical scientists, while others completely rejected the adoption of the medical scientists' standard (Albert, Paradis, and Kuper 2015). The work of Albert and his colleagues suggests that the study of various scientists' habitus may offer insight into the often invisible mechanism of how scientists' trained dispositions result in unexpected organizational outcomes.

Second, empirical verification of habitus is challenging. Because habitus operates beneath the level of consciousness (Wacquant 2011), interviewees typically would not be able to report directly on their use of habitus. Furthermore, habitus is an inherently relational concept that manifests the connection among social agents' habitual behaviors, institutional trajectory of individuals, and social and historical backgrounds and outcomes: failing to address these relations invalidates the merits of the concept.

Because unconscious choices are connected with institutional and structural contexts, studying habitus demands long-term immersive studies. Sociologists have suggested methods to mobilize various theoretical and methodological assemblages of ethnography to uncover social structural contexts and hidden motivations of actors behind the scene, and to connect such empirical data with broader social theories (Burawoy 1998; Desmond 2014; Jerolmack and Khan 2017; Smith 2005; Tavory and Timmermans 2009). Bourdieu contended that ethnographers should gaze beyond "spontaneous sociology"—a positivistic study of a superficial level of social scenes without making connections with structural and historical fabrics. In this context, according to Bourdieu, "the truth of the interaction is not to be found in the interaction itself" (Bourdieu 2005, 148). Therefore, to study habitus, the objects of research should include not only interactions that are observed by researchers, but also *relations* that contextualize such movements via-a-vis histories that agents passed through and social structure in which agents are embedded.

Despite these challenges, scientific habitus offers a potentially valuable tool in the study of science and scientists. Ultimately, a greater integration of Bourdieu's theory of habitus and STS—focused on sometimes-hidden logics and mechanisms that produce systematically unjust science—is promising in its potential to provide a better guide for potential interventions into scientific practices under various social and institutional contexts.

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References

Albert, Mathieu, and Daniel Lee Kleinman. 2011. "Bringing Pierre Bourdieu to Science and Technology Studies." *Minerva* 49 (3): 263–73.

Albert, Mathieu, and Suzanne Laberge. 2017. "Confined to a Tokenistic Status: Social Scientists in Leadership Roles in a National Health Research Funding Agency." *Social Science & Medicine* 185: 137–46.

Albert, Mathieu, and Elise Paradis. 2014. "Social Scientists and Humanists in the Health Research Field: A Clash of Epistemic Habitus." *Routledge Handbook of Science, Technology, and Society*, 391–409.

Albert, Mathieu, Elise Paradis, and Ayelet Kuper. 2015. "Interdisciplinary Promises versus Practices in Medicine: The Decoupled Experiences of Social Sciences and Humanities Scholars." *Social Science & Medicine* 126: 17–25.

Baker, Zeke. 2017. "Climate State: Science-State Struggles and the Formation of Climate Science in the US from the 1930s to 1960s." *Social Studies of Science* 47 (6): 861–87.

Bourdieu, Pierre. 1975. "The Specificity of the Scientific Field and the Social Conditions of the Progress of Reason." *Information (International Social Science Council)* 14 (6): 19–47.

———. 1977. *Outline of a Theory of Practice. Richard Nice, Trans*. Cambridge: Cambridge University

———. 1979. *Algeria 1960: The Disenchantment of the World, the Sense of Honor, the Kabyle House or the World Reversed*. Cambridge: Cambridge University Press.

———. 1984. *Distinction : A Social Critique of the Judgement of Taste*. Harvard University Press.

———. 1987. "What Makes a Social Class? On The Theoretical and Practical Existence Of Groups." *Berkeley Journal of Sociology* 32: 1–17.

———. 1988. *Homo Academicus*. Stanford University Press.

———. 1990. *The Logic of Practice*. Stanford University Press.

———. 1991. *Language and Symbolic Power*. Harvard University Press.

———. 1993. "Manet and the Institutionalization of Anomie." In *The Field of Cultural Production*, 238–53. Polity Press Cambridge.

———. 2000. *Pascalian Meditations*. Stanford University Press.

———. 2004a. *Science of Science and Reflexivity*. University of Chicago Press.

———. 2004b. "The Peasant and His Body." *Ethnography* 5 (4): 579–99.

———. 2005. *The Social Structures of the Economy*. Polity Press.

———. 2008. *The Bachelors' Ball: The Crisis of Peasant Society in Bearn*. Polity Press.

Bourdieu, Pierre, Jean-Claude Chamboredon, and Jean-Claude Passeron. 1991. *The Craft of Sociology: Epistemological Preliminaries*. Walter de Gruyter.

Bourdieu, Pierre, and Loïc Wacquant. 1992. *An Invitation to Reflexive Sociology*. University of Chicago Press.

Brubaker, Rogers. 1993. "Social Theory as Habitus." *Bourdieu: Critical Perspectives*, 212–34.

Burawoy, Michael. 1998. "The Extended Case Method." *Sociological Theory* 16 (1): 4–33.

Burt, Ronald S. 2004. "Structural Holes and Good Ideas." *American Journal of Sociology* 110 (2): 349–99.

Camic, Charles. 2011. "Bourdieu's Cleft Sociology of Science." *Minerva* 49 (3): 275–93.
———. 2013. "Bourdieu's Two Sociologies of Knowledge." In *Bourdieu and Historical Analysis*. Duke University Press.
Clarke, Adele E., and Joan H. Fujimura. 1992. *The Right Tools for the Job : At Work in Twentieth-Century Life Sciences*. Princeton University Press.
Collins, Harry M. 2010. *Tacit and Explicit Knowledge*. Univ. of Chicago Press.
Collins, Harry M. 1974. "The TEA Set: Tacit Knowledge and Scientific Networks." *Social Studies of Science* 4 (2): 165–85.
Desmond, Matthew. 2008. *On the Fireline: Living and Dying with Wildland Firefighters*. University of Chicago Press.
———. 2014. "Relational Ethnography." *Theory and Society* 43 (5): 547–79.
DiMaggio, Paul. 1979. "On Pierre Bourdieu." University of Chicago Press.
Emirbayer, Mustafa, and Victoria Johnson. 2008. "Bourdieu and Organizational Analysis." *Theory and Society* 37 (1): 1–44.
Etzkowitz, Henry. 2003. "Research Groups as 'Quasi-Firms': The Invention of the Entrepreneurial University." *Research Policy* 32 (1): 109–21.
———. 2008. *The Triple Helix: University-Industry-Government Innovation in Action*. Routledge.
Etzkowitz, Henry, and Loet Leydesdorff. 2000. "The Dynamics of Innovation: From National Systems and 'Mode 2' to a Triple Helix of University–Industry–Government Relations." *Research Policy* 29 (2): 109–23.
Foster, Jacob G, Andrey Rzhetsky, and James A Evans. 2015. "Tradition and Innovation in Scientists' Research Strategies." *American Sociological Review* 80 (5): 875–908.
Frickel, S., S. Gibbon, J. Howard, J. Kempner, G. Ottinger, and D. J. Hess. 2010. "Undone Science: Charting Social Movement and Civil Society Challenges to Research Agenda Setting." *Science, Technology & Human Values* 35 (4): 444–73.
Fujimura, Joan H. 1987. "Constructing 'Do-Able' Problems in Cancer Research: Articulating Alignment." *Social Studies of Science* 17 (2): 257–93.
———. 1988. "The Molecular Biological Bandwagon in Cancer Research: Where Social Worlds Meet." *Social Problems* 35 (3): 261–83.
———. 1992. "Crafting Science: Standardized Packages, Boundary Objects, and 'Translation.'" In *Science as Practice and Culture*, edited by Andrew Pickering. University of Chicago Press.
———. 1996. *Crafting Science : A Sociohistory of the Quest for the Genetics of Cancer*. Harvard University Press.
Garfinkel, Harold, Michael Lynch, and Eric Livingston. 1981. "The Work of a Discovering Science Construed with Materials from the Optically Discovered Pulsar." *Phil. Soc. Sci* 11: 131–58.
Gauchat, Gordon. 2011. "The Cultural Authority of Science: Public Trust and Acceptance of Organized Science." *Public Understanding of Science* 20 (6): 751–70.
Gauchat, Gordon, and Kenneth T Andrews. 2018. "The Cultural-Cognitive Mapping of Scientific Professions." *American Sociological Review* 83 (3): 567–95.
Gibbons, Michael. 1994. *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. Sage.

———. 2000. "Mode 2 Society and the Emergence of Context-Sensitive Science." *Science and Public Policy* 27 (3): 159–63.

Gieryn, Thomas F. 2006. "Review: Science of Science and Reflexivity." *Contemporary Sociology* 35 (2): 185–87.

Gilbert, G Nigel, and Michael Mulkay. 1984. *Opening Pandora's Box: A Sociological Analysis of Scientists' Discourse*. CUP Archive.

Gingras, Yves. 2006. "Science of Science and Reflexivity." *Journal of the History of the Behavioral Sciences* 42 (4): 407–9.

Hackett, Edward J. 1990. "Science as a Vocation in the 1990s: The Changing Organizational Culture of Academic Science." *The Journal of Higher Education* 61 (3): 241–79.

Hammarfelt, Bjorn, Ssrah de Rijcke, and Alexander D Rushforth. 2016. "Quantified Academic Selves: The Gamification of Science through Social Networking Services." *Information Research* 21.

Hess, David J. 2009. "The Potentials and Limitations of Civil Society Research: Getting Undone Science Done." *Sociological Inquiry* 79 (3): 306–27.

———. 2011. "Bourdieu and Science and Technology Studies: Toward a Reflexive Sociology." *Minerva* 49 (3): 333–48.

———. 2015. "Undone Science and Social Movements." *Routledge International Handbook of Ignorance Studies*, 141–54.

———. 2016. *Undone Science : Social Movements, Mobilized Publics, and Industrial Transitions*. Cambridge: MIT Press.

Holmes, Seth. 2013. *Fresh Fruit, Broken Bodies: Migrant Farmworkers in the United States*. Vol. 27. Univ of California Press.

Jerolmack, Colin, and Shamus Khan. 2017. "The Analytic Lenses of Ethnography." *Socius*

Jordan, Kathleen, and Michael Lynch. 1992. "The Sociology of a Genetic Engineering Technique: Ritual and Rationality in the Performance of the 'Plasmid Prep.'" In *The Right Tools for the Job: At Work in Twentieth-Century Life Sciences*, 77–114. Princeton University Press.

———. 1998. "The Dissemination, Standardization and Routinization of a Molecular Biological Technique." *Social Studies of Science* 28 (5–6): 773–800.

Kaltenbrunner, Wolfgang. 2018. "Situated Knowledge Production, International Impact: Changing Publishing Practices in a German Engineering Department." *Minerva* 56 (3): 283–303.

Kleinman, Daniel Lee. 1998. "Untangling Context: Understanding a University Laboratory in the Commercial World." *Science, Technology, & Human Values* 23 (3): 285–314.

———. 2003. *Impure Cultures: University Biology and the World of Commerce*. Univ of Wisconsin Press.

Kleinman, Daniel, and Steven P Vallas. 2001. "Science , Capitalism , and the Rise of the "knowledge Worker ' ': The Changing Structure of Knowledge Production in the United States." *Theory and Society* 30: 451–92.

Knorr-Cetina, K. 1999. *Epistemic Cultures : How the Sciences Make Knowledge*. Harvard University Press.

Lamont, Michèle. 2010. "Looking Back at Bourdieu." *Cultural Analysis and Bourdieu's Legacy: Settling Accounts and Developing Alternatives*, 128–41.

Latour, Bruno., and Steve. Woolgar. 1986. *Laboratory Life : The Construction of Scientific Facts*. Princeton University Press.

Lynch, Michael. 1997. *Scientific Practice and Ordinary Action: Ethnomethodology and Social Studies of Science*. Cambridge University Press.

Mears, Ashley. 2015. "Working for Free in the VIP: Relational Work and the Production of Consent." *American Sociological Review* 80 (6): 1099–1122.

Nelson, Nicole C. 2013. "Modeling Mouse, Human, and Discipline: Epistemic Scaffolds in Animal Behavior Genetics." *Social Studies of Science* 43 (1): 3–29.

Panofsky, Aaron L. 2011. "Field Analysis and Interdisciplinary Science: Scientific Capital Exchange in Behavior Genetics." *Minerva* 49 (3): 295–316.

Polanyi, Michael. 1958. *Personal Knowledge*. Routledge.

Rushforth, Alexander, Thomas Franssen, and Sarah de Rijcke. 2018. "Portfolios of Worth: Capitalizing on Basic and Clinical Problems in Biomedical Research Groups." *Science, Technology, & Human Values* 44 (2): 209–36.

Rushforth, Alexander, and Sarah de Rijcke. 2015. "Accounting for Impact? The Journal Impact Factor and the Making of Biomedical Research in the Netherlands." *Minerva* 53 (2): 117–39.

Sallaz, Jeffrey J, and Jane Zavisca. 2007. "Bourdieu in American Sociology, 1980–2004." *Annu. Rev. Sociol.* 33: 21–41.

Shinn, Terry. 2002. "The Triple Helix and New Production of Knowledge: Prepackaged Thinking on Science and Technology." *Social Studies of Science* 32 (4): 599–614.

Shwed, Uri, and Peter S Bearman. 2010. "The Temporal Structure of Scientific Consensus Formation." *American Sociological Review* 75 (6): 817–40.

Sismondo, Sergio. 2011. "Bourdieu's Rationalist Science of Science: Some Promises and Limitations." *Cultural Sociology* 5 (1): 83–97.

Slaughter, Sheila, and Gary Rhoades. 2004. "The Theory of Academic Capitalism." *Academic Capitalism and the New Economy: Markets, State, and Higher Education*, 1–34.

Smith, Dorothy E. 2005. *Institutional Ethnography: A Sociology for People*. Rowman Altamira.

Star, Susan Leigh. 1983. "Simplification in Scientific Work: An Example from Neuroscience Research." *Social Studies of Science* 13 (2): 205–28.

Suryanarayanan, Sainath, and Daniel Lee Kleinman. 2016. *Vanishing Bees : Science, Politics, and Honeybee Health*. Rutgers University Press.

Swartz, David. 1997. *Culture and Power : The Sociology of Pierre Bourdieu*. University of Chicago Press.

Swartz, David L, and Vera L Zolberg. 2006. *After Bourdieu: Influence, Critique, Elaboration*. Springer Science & Business Media.

Tavory, Iddo, and Stefan Timmermans. 2009. "Two Cases of Ethnography: Grounded Theory and the Extended Case Method." *Ethnography* 10 (3): 243–63.

Traweek, Sharon. 1988. *Beamtimes and Lifetimes : The World of High Energy Physicists*. Harvard

University Press.

Vallas, Steven Peter, and Daniel Lee Kleinman. 2007. "Contradiction, Convergence and the Knowledge Economy: The Confluence of Academic and Commercial Biotechnology." *Socio-Economic Review* 6 (2): 283–311.

Vaughan, Diane. 2008. "Bourdieu and Organizations: The Empirical Challenge." *Theory and Society* 37 (1): 65–81.

Wacquant, Loïc. 1995. "Pugs at Work: Bodily Capital and Bodily Labour among Professional Boxers." *Body & Society* 1 (1): 65–93.

———. 2011. "Habitus as Topic and Tool: Reflections on Becoming a Prizefighter." *Qualitative Research in Psychology* 8 (1): 81–92.