Technical, arcane, interpersonal, and embodied expertise

Joshua B. Barbour

University of Texas at Austin

Rebecca Gill

Massey University

Paul A. Sommer

Kent State University at Stark

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Abstract

Expertise matters at work in part because it has implications for functional outcomes (e.g., having the knowledge needed to get the work done), but also because it has implications for the meaning and legitimacy of work. Expertise confers power. Building on previous work that has compartmentalized the expertise differences according to discrete knowledge areas or knowledge typologies, we enumerate a taxonomy of expertise forms: technical, arcane, relational, and embodied. This taxonomy illuminates how the practice of expertise involves knowledge about the technical properties of work; the policies, standards, and laws that govern it; the people involved; and a material sense of the spaces in which work takes place. We argue that experts must negotiate the multiplicity of their expertise in their interaction with different audiences and that these forms of expertise involve differing standards of legitimate performance, differing encumbrance on the work of others, and differing sources of authority.

Technical, arcane, interpersonal, and embodied expertise

Organizational efforts to coordinate expertise or derive and capture value from expertise are famously ineffective and prone to failure (Chua & Lam, 2005; Leonardi & Treem, 2012). Technological interventions aimed at harnessing or supporting the creation, use, and capture of the organizational knowledge held by experts have an especially uneven track record (Flanagin, Pearce, & Bondad-Brown, 2009; Huang, Barbour, Su, & Contractor, 2013). Addressing the short-comings of these efforts depends on conceptualizing expertise and expert knowledge work to account for the emergent and situational character of knowing and the practice of expertise.

Efforts toward such conceptualizations tend to emphasize the problem-centered, situational, and community-driven character of knowing and expertise. Kuhn and Jackson (2008) defined knowledge as having "a capacity to act within a situation" (p. 473), and knowledge work as a communicative accomplishment in the sense that "knowledge in a given context is simply that which enables and sustains problem solving and not necessarily that which can be independently justified as *true*" (p. 456). Experts, then, are those who have a distinctive capacity for solving particular sorts of problems or at least those individuals thought of in organizations as having such capacities (Alvesson, 2001; Treem, 2012).

Given this framing, resources for understanding the variability of knowing and the practice of expertise are key. We seek an understanding of expertise heterogeneity that focuses on differences in the provision of the authority to act or to encumber others to act. Ignoring the heterogeneity of knowing can "oversimplify and sterilize practice" (Kuhn & Jackson, 2008, p. 473), which may limit efforts to reveal why and when knowing contributes to problem-solving. Problem- and situation-focused frameworks for expertise should be useful *because* they surface difference.

Previous efforts to categorize knowing and expertise have proven useful but not unproblematic (Alvesson, 2001). Research has demonstrated that expertise coordination processes differ depending on knowledge areas or domains (Boh, Ren, Kiesler, & Bussjaeger, 2007; Huang et al., 2013; Yuan, Fulk, Monge, & Contractor, 2010). In a given situation, individuals may possess and employ similar expertise but to different effects, because of power differences or because the performance of their expertise differs. A focus on expertise heterogeneity brings attention to "why certain forms of expertise become valued in organizational environments whereas others are not" (Treem, 2012, p. 44).

Doing so may help illuminate how privileged forms of expertise reinforce established knowledge and ways of knowing, which may inhibit innovation (Styhre, 2009) or make more difficult communication among individuals with varying expertise (Barbour & James, forthcoming). For example, research and theorizing of expertise coordination and knowledge-intensive work tends to focus on the possession and manipulation of cognition in text work such as accounting, lawyering, professing, and engineering, obscuring how expertise in these settings may be different from *and* similar to the knowing in body work or craftwork (Dougherty, 2011; Gherardi & Nicolini, 2002; Gibson & Papa, 2000; Sennett, 2009).

Kuhn and Jackson (2008, p. 473) argued of their knowledge-accomplishing framework that "diverse or heterogeneous knowledge is key to the conception of episodes and knowledge-accomplishing interaction. As people frame situations, differences in knowledge (e.g., expert/novice) and in approaches to problem solving (i.e., what is considered appropriate) frequently surface" (p. 473). Their efforts to explicate heterogeneity focused on the expert/novice and appropriate/inappropriate distinctions, and they also argued that accounting for interaction of community and difference in knowing is key: "studies of knowing tend to ignore knowledge

diversity when they attend to community influences" (p. 473). The goal of this essay is to conceptualize knowledge heterogeneity as key to understanding expertise power dynamics, which center on perceptions of legitimacy, encumbering other actors, and acting with authority (see also Kuhn & Rennstam, this volume).

To do so, rather than treating expertise as an attribute of an individual, we underpin the essay with a conceptualization of expertise as relational, practiced, and macromorphic. Expertise is **relational** in the sense that, for example, team members are experts not just because of what they know but because of what the other team members think they know (Hollingshead & Brandon, 2003; Ren & Argote, 2011). Expertise is negotiated in interaction with different audiences (Hollingshead & Brandon, 2003). In these ways, expertise is contingent on the particular problematic situation at hand and the communicators implicated in that situation (Kuhn & Jackson, 2008). In the **practice** of expertise, experts construct and project expertise as part of their identity and impression management (Alvesson, 2001; Leonardi & Treem, 2012). Tsoukas and Vladimirou (2001) argued that the ability to put what we know to use is a matter of socialization, and by extension therefore, its constitutive processes of identity formation and negotiation (see also Gherardi & Nicolini, 2002). The socialization of experts is tied to extra-organizational moorings of what counts as legitimate expertise (Taylor & Van Every, 2014). Expertise is **macromorphic** in the sense that it is entwined with extra-organizational perceptions, certifications, messages, and constellations of beliefs and practices that cast us in particular roles (Barbour, 2010; Lammers & Barbour, 2006). The macromorphic character of expertise is in particular clear in professional contexts (Barbour & Lammers, 2015; Scott, 2008), but it is evident to varying degrees in the practice of expertise generally where systemic, shared

beliefs about expert work inform "who has responsibility for what, who is entitled to play which role, and how the resulting outcomes will be distributed" (Taylor & Van Every, 2014, p. 9).

We focus in this essay then on how and why expertise has the power to classify, frame problematic situations, and bring interactions to a close through an analysis of particular vignettes or episodes of expertise in practice. In this essay, we seek to answer the question, *how do different forms of expertise act and interact to accomplish knowledge work*? We first explicate a taxonomy of expertise forms emergent from the vignettes (see Table 1). For each episode, we tell the story, then we focus on how those involved framed the problem and deployed or developed knowledge to try solve the problem (Kuhn & Jackson, 2008). We conclude by returning to the taxonomy to explicate a research agenda for the study of knowing and expertise informed by an understanding of the heterogeneity of expertise.

A Taxonomy of Expertise Forms

Our taxonomy elucidates the heterogeneity of expertise by highlighting the different forms and functions of expertise at work in work (see Table 1). Expertise performances—the application of knowing to solve problems—reflect a mix of the *technical, arcane, interpersonal, and embodied,* and particular expertise performances no doubt emphasize particular dimensions. Expertise mobilizes power through the legitimacy it confers, the encumbering of other actors, and a basis in authority that is macromorphic (Alvesson, 2001; Lammers, 2011; Scott, 2008).

Taylor and Van Every (2014) argued that judgments about expertise depend on "thirdness…a body of understanding about an object, shared by a community, usually expressed in language, of what the work or other sustained activity they are engaged in means, and how it should be done" (p. 9). Expertise involves authority separate but related to orthodox organizational hierarchies. Expertise draws its authority from constructed differences in

knowing. Experts have disproportional authority to decide—"to author the trajectory of practice" (Kuhn & Rennstam, this volume), because they have disproportionate claims to knowledge. Expertise is judged as legitimate and therefore has authority to encumber others when it is appropriate and efficacious (i.e., the expertise does what it claims to be able to do, solves the problems it means to in accepted ways). Expertise authority is the power to encumber that is perceived to be legitimate, because it is "in concordance with existing and accepted organizational texts, scripts, or structures" (Kuhn & Rennstam, this volume).

Our taxonomy explores how expertise performances encumber through different sources of legitimacy and authority. The taxonomy is cross-cutting. Whereas research has previously contrasted, for example, implicit/tacit and explicit knowing (Collins, 2011), the technical, arcane, interpersonal, and embodied dimensions of expertise that we frame in our taxonomy each have tacit and explicit elements. Whereas other research looks at expertise specific to knowledge areas (e.g., topics, domains), we expect that any given knowledge area has technical, arcane, interpersonal, and embodied forms. However, we offer the taxonomy not as a replacement for these well-established and insightful conceptualizations of knowing and expertise difference, but rather as another alternative that highlights the differences in legitimacy, authority, and encumbering among expertise forms. The taxonomy is not an end, but is an incomplete list of expertise forms that is useful to the extent it makes these differences clearer. The taxonomy is then less about categorizing expertise functions and more about categorizing the means of the communicative accomplishment of expertise. If we expect (a) any given expertise performance to involve technical, arcane, interpersonal, and embodied expertise, but (b) to varying degrees of salience and importance, then (c) the taxonomy will bring into relief the operation of different

means in any given performance. The purpose of the taxonomy is to orient researchers to the interactions among these expertise forms.

When most of us think about expertise, **technical expertise** comes to mind first. Indeed, we developed the taxonomy in part by looking for aspects of expertise performances that were not technical. The technical character of expertise centers on the specific knowledge needed for the work—the "know what." A physician visiting with a patient knows the functioning of the human body. An attorney writing a brief knows the facts of a case. A public relations professional who is preparing a campaign knows the background of the issues at stake. An engineer digging an unconventional natural gas well understands the physical forces in play. Studies of expertise that ask us to describe the people we work with in terms of what they know typically focus on technical forms of expertise. We judge technical expertise as effective and legitimate when it accurately and correctly yields facts or solutions. Technical expertise encumbers other actors, because the names and frames for problems and solutions it offers seem true and legitimate, thereby categorizing organizational activity according to established knowledge. Experts draw technical expertise from professional status earned or indicated through formal study or work experience or apprenticeship.

Arcane expertise focuses on mastery of the rules, laws, and legitimated procedures. A physician knows the privacy rules for interacting with patients and the complex systems of procedures used to bill and pay for care. An attorney writing a brief knows the law. A public relations professional who is preparing a campaign knows the ethical rules for conduct. An engineer digging an unconventional natural gas well understands the regulations governing their work. Our attorney example is particularly useful for drawing the distinction between technical and arcane expertise. An attorney knows the law in the same sense that she or he knows the facts

of a case, but the nature of each dimension of expertise is different. Whereas the facts of the case encompass actual happenings, the law reflects a system of rules and procedures. That is, the law, regulations, and ethical codes may have their basis in historical events and technical facts, but knowing them means knowing the codes, rules, and conventions that govern work more broadly. Thus, it is arcane in the sense that it is mysterious, open to only those initiated in the system of meaning. The operation of courtroom rules are specific to particular communities and unwritten depending on apprenticeship in particular courts. To term this expertise "arcane" is to emphasize its obscurity relative to the others. We judge arcane expertise as effective and legitimate when it provides a convincing reading of the situation at hand that fits (or makes it fit) established conventions. Arcane expertise encumbers other actors, because it adjudicates expert conduct and conduct governed by expertise. Experts draw arcane expertise from the law, policy, or professional standards and the force and consequence of those conventions.

Interpersonal expertise focuses on the relationships and relational history implicated in a problematic situation. A physician knows to varying degrees their history with the patients and the nurses involved in providing care. An attorney writing a brief has a sense of her relationships with her clients and the opposing counsel. A public relations professional who is preparing a campaign knows the media professionals to whom he will need to reach out. An engineer digging an unconventional natural gas well knows the other people at the pad.

Put another way, research emphasizes the relational character of expertise without making clear that relationships *themselves* are a domain of expertise. That is, all expertise is to a degree relational; expertise is judged by other experts; experts are defined as such in part by others seeing them as experts; however, our concern for interpersonal expertise focuses in particular on the knowing of those involved in work (not the fact that this knowing is itself

relational). Interpersonal expertise focuses on the people involved in the work and their relational histories distinct from the relational character of all aspects of expertise.

Relationships are themselves a subject of expertise that reflects a knowing of the people involved, an understanding of their identities in the context of the state of relationships among them. To offer an oversimplified heuristic, if technical expertise is of facts and arcane expertise of conventions, interpersonal expertise is of relationships between people. We judge interpersonal expertise as effective and legitimate when it captures the relationships among those involved in a given problematic situation (i.e., when it answers "who are they?" "how have they treated us?" "what kind of people are they?" "can they be trusted?"). Interpersonal expertise encumbers other actors because it reflects an useful awareness of how people are connected to one another. Experts draw interpersonal expertise from their history in the relationships and their understanding of who knows whom and how they know them.

Finally, **embodied expertise** exists in the physical conduct of the work and the arrangement of the work space. That is, expertise exists not just in the mind of the expert but also in the disciplined bodies that they use in knowledge work. A physician has a gut feeling about a patient's overall health before consulting a specific diagnostic tool. An attorney working on a brief is spurred on by a visualization and felt understanding of the space and interactions in a courtroom. A public relations campaigner has an instinctual read of the tone of an interaction with a journalist. An engineer experiences a visceral sense of the state of drilling at the pad. In other words, expertise is as much about the lived, embodied experience of knowing and knowledge as it is about the cognitive constructs and schema we typically associate with being an expert. Embodied expertise focuses on the physical conduct of the work and the arrangement of the space of work over time. We judge the performance of embodied expertise by the wisdom

exercised in particular spaces, the reading of the material conditions, the insight about the timing of work. Embodied expertise encumbers other actors because it sees, hears, smells, feels, or tastes an aspect of the work that others cannot, because it can perform an action with greater skill, or because it controls the physical space with greater force. The authority of embodied expertise centers on the material conditions of the work itself.

Narrative Interrogation of the Taxonomy

Having unpacked the taxonomy, we turn now to a pair of vignettes. The goal of these narratives is to provide extended examples that may be used to interrogate the boundaries of the taxonomy and to explore the interactions among them. The narratives, which focus on resident inspectors and construction project managers, are derived from the authors' research in nuclear power plants (Barbour & Gill, 2014; Gill, Barbour, & Dean, 2014) and on construction sites, but we offer them not so much as empirical data but as examples that are useful on their face (Jacobs, 1986). The narratives were selected from the authors experiences as exemplary problematic situations (Kuhn & Jackson, 2008), and they are described here as vignettes to capture the use of different forms of expertise to solve a problem.

As coherent examples, they offer space to explore the taxonomy to the extent that they are plausible (Jacobs, 1986). Stories taken from these two occupational areas are especially useful because they reflect hybrids of body and text work (Dougherty, 2011; Marvin, 1994). Construction work is physical, but it also involves knowledge-intensive decision making (Bartholomew, 2008; Egbu & Robinson, 2005), and expertise recognition is established through knowledge in physical work and learning-by-doing (Styhre, 2008). And, the regulation of complex industrial systems such as nuclear power plants involves knowledge of engineering, craft, procedure, and law, and the work takes place in a physical plant as well as orthodox office

settings (Barbour & Gill, 2014). We proceed by telling the stories and highlighting the technical, arcane, interpersonal, and embodied expertise therein.

Steel Reinforcement

As a concrete contractor, after the major pours were complete, I worked a strike list, fixing issues in the construction. Finishing the items on time was essential, because the work could hold up other trades working in the space. I parked, walked into work, and after our morning briefing, we divided up to work on particular projects throughout the site. The architect had noticed a change in the placement of windows that was not consistent with the original design. To address this, concrete support beams (approximately 2.5 by 2.5 feet in size) running between the windows needed to be cut to make room for the new window placement. The engineer on the site called for additional reinforcement in the form of steel plates that could help carry the load across the modified beams. These supports ran above and below the concrete floor between the first and second floor, and needed to be connected with vertical steel plates that had to pass through the floor where it intersected with the exterior concrete wall. Post-tension cables ran through the floor to provide structural support and prevent cracking. We could not rip up the entire floor to attach one steel plate; we could not see exactly where the post-tension cables were either. Once the concrete floor had been poured, the cables had been put under extreme pressure by stretching them from the outside, hence the post-tension name. Severing one might cause it to tear out of the floor like a rubber band snapping. We needed to remove part of the floor next to the wall to insert the steel support without disturbing a cable.

The blue prints and specifications for post-tension cable installation indicated in general terms the number of cables and how far apart they should have been placed, but not the exact locations. A certain amount of flexibility was needed during the pouring process. The only way

to proceed was to chip into the floor from above and below, feeling our way through and hoping we picked the right spot. We chipped away at the floor along the wall with a hammer drill fitted with a spade bit. The two of us who were chipping were told that if we struck a post-tension cable with our hammer drill, there was a chance it could snap up and out of the concrete floor. The foreman warned, "If you hit something that feels like metal, stop."

I chipped away concrete from the floor while another team member chipped away from the floor below. I made contact with metal. The vibration changed. I could feel it in my hands, and I could see some rusty steel through the dust and chunks of concrete. It was rebar used to strengthen the concrete, and not a plastic wrapped steel cable. We eventually created a hole big enough for the additional support without encountering a post-tension cable.

We had to attend to the architect and engineer, because of their credentials and the building contracts and legal frameworks that give them the authority to make decisions on the project. But on the job site, problems were going to be addressed using knowledge that came not just from books and the office, but from years of hands-on work. The blue prints may say one thing, but I know what is and what is not going to work in the space. I had to satisfy the engineer and do the work nonetheless, and I had to do it with the materials and physical access I had.

This vignette involves multiple expertise interactions. Technical expertise included the knowledge of forces involved and how materials will respond to those forces as hammer drills were used to chip away at the concrete (i.e. choosing the right tool for the job). The architect wielded technical expertise in his recognition of the need to address the window location in the first place, and the engineer did as well in the design of the reinforcements that were to be used to accommodate the modified exterior structure. Yet, the technical mastery of the engineer and architect were in direct conflict with the embodied and arcane expertise of the concrete

contractor who knew the time, money and potential safety risks involved with such a complex solution. The contractor had a gut-level sense of the time and financial realities at the site, which drew legitimacy from his experience on jobs past. Arcane expertise included myriad relevant but conflicting safety regulations and building codes. The contractors had to make the building safer (e.g., with the steel plate) while creating hazards for themselves (e.g., "if you hit something that feels like metal, stop"). The hierarchy of the job site dictated, by virtue of the arcane, that if an architect asked for a change, the engineer was required to provide a solution in accordance with the laws and regulations which governed the modification of structural concrete and steel, as long as that request fell within the powers afforded to the architect within their contract.

He also trusted the embodied expertise of the person doing the drilling. He was confident that the other person would not put his safety in danger by trying to chip away at a post tension cable from below. The two performing the work had done work together before, understood that one another would know what it would feel like to strike a steel cable during the process. The embodied expertise was particularly important, because of the physical realities of the site. The contractors could not get access to where they need to place the plate, and they could not rip up the entire floor. Although the project manager was present when they poured the floor, he could not be sure exactly where the cables were located. They had to act by feel—an embodied knowing of the work (Sennett, 2009), and they knew they could do so because they knew that the feel of the cable would be different, and that they could stop before damaging a cable.

The contractor drew on his interpersonal expertise as well. He asked if this was an engineer he trusted. He was asking, in other words, if the reinforcement was completely necessary, or just "over-engineering." He used what he knew of the people and the physical site to negotiate competing implications of expertise forms.

Walking Down the Control Room

A visit to the control room is a typical, day-to-day activity of resident inspectors at nuclear power plants. Walking into the control rooms with the inspectors, I noticed a quiet hum, the armed guards doing their rounds, and the walls of lights, screens, instrumentation, switches, and handles. The beige and black boards held analog dials with indicators and plastic, color-coded lighted switches. Plastic signs labeling the different parts of the plant organized the boards into sections. A few monitors had been replaced with digital screens. A glass wall surrounded the boards, separating the disciplined space from the quiet offices surrounding it. We stopped and talked to a manager about the previous night's logs and a few ongoing issues. Before he even coming to the room, he had skimmed the log.

We stepped to the opening of the control room, and we asked permission to enter. The operator turned to us, and replied we could. We walked along, stopping for whispered questions and explanations. I asked if the inspector knew what all the switches meant and what the indicators should read. He pointed to the stacks of binders under the boards—instruction manuals, explaining that he knew much of the boards. He told the story of being visited by leaders who would quiz him. He shared that knowing the boards were less about memorizing the meaning of every indicator, although knowing that was important too. Instead, as he walks through he can take in the board as a whole.

He explained that he has to know both. He has to know the look of the boards. He also has to know the meaning behind all the board's indicators, but he can find that information if he needs it. A person can sit at the office and memorize the details of the boards, but it takes time at a plant in the space of control room to develop a sense of the board. That sense can be useful,

but, he warned that inspectors have to be careful they do not confuse what is normal from what ought to be or what is.

This narrative reflects how the technical expertise needed for "walking down the boards" included the engineering knowledge about the reactors and the systems that support them. The expertise was legitimate, because of his training and mastery of the documentation of the technical specifications of this plant and others. Being in the space also meant knowing the arcane, such as the rules that governed the room (e.g., the control room log, the rules for shifts, the legal and policy control of the space). His knowledge of the arcane empowered him to be in the space at all, and to translate his understanding of problems (if any) into action.

Later, the inspector reflected on his history with the particular manager to whom we spoke—interpersonal expertise in the history of past interactions and experiences with particular reactor staff. His interpersonal expertise could influence because he could use what he knew to make judgments about the information he was gathering. It could influence with legitimacy, because of the history he had accrued with that person and who they were in relationship to each other (inspector-manager). But the practice of walking down the boards was as much about the look of the board, the gestalt of what it ought to be, as it was about tracking down a particular issue in the boards. His embodied expertise was useful for action and legitimate, because of all of the times had walked down the boards in the past. However, the inspectors' warning also demonstrates that one form expertise operating in a space can obscure others. The embodied sense of what the boards ought to look like captures what is normal but not, per se, what they ought to look like when the plant was operating properly.

Revisiting the Framework: An Agenda for Inquiry in Research and Practice

By surfacing the heterogeneity of expertise, the taxonomy raises questions about how these forms interact. This taxonomy of different forms of expertise is valuable, because it enriches our understanding of the relational character of expertise and existing models of expertise coordination. We argue that the study of expertise should integrate a focus on (a) interaction among forms of expertise with a particular concern for how differences in knowing (b) are negotiated in relationships (c) with differing implications for expertise coordination.

Interaction of Expertise Forms

In the stories above, expertise amplified, contradicted, negotiated, and obscured expertise. Answering why and how particular forms of expertise have authority and encumber others in organizing means understanding those interactions. In situations where forms of expertise agree, we would expect them to **amplify** each other, meaning that the framing of the problem should be even clearer, the encumbering even stronger, the legitimacy of a particular take more supported than would be expected otherwise, because a particular reading of the situation draws on multiple forms of authority. In the vignettes above, the inspectors hoped their technical and embodied expertise would work together to make clearer what was happening in the control room. Research informed by an interest in expertise heterogeneity should look for how different forms of expertise may build on each other to offer more and more forceful interpretations and decisions.

When expertise forms disagree or **contradict** each other, researchers should be prompted to ask how and why particular forms of expertise are ascendant in a given situation. In the stories above, the embodied expertise of the concrete contractor drilling into a building's support structure was ascendant. It allowed those involved to solve the problem at hand despite the concerns raised by relevant arcane expertise (i.e., safety regulations) and in service of other

arcane expertise (i.e., the requirements of building code). The contractors' embodied expertise addressed shortcomings in technical expertise (i.e., the lack of knowledge about the exact locations of post-tension cables).

As contradiction points to questions about the relative power of expertise forms, we expect the struggle over the framing of problematic situations to draw on the authority of expertise judged the most efficacious (problem-solving), where efficacy depends on the particular situation. The notion of contradictory expertise might prompt researchers to make predictions about the contingent authority of expertise. However, instead of trying only to predict which aspect of expertise will rule the day when they conflict, the taxonomy orients the analyst to how actors draw on different forms of expertise to classify problems, make arguments about appropriate solutions, and in the end, act. The struggle among competing expertise forms implicates not only the struggle to act in problematic situations, but also the competition among experts for the legitimacy of particular readings of situations over others, which is at the heart of collective expert identity negotiation (Barbour & James, forthcoming). These struggles for legitimacy (and in turn authority and encumbering) are evident too when experts challenge each other's judgment, decide what information to share and what not, and negotiate technological and organizational change (Barbour, 2010).

Expertise forms may also not agree without necessarily contradicting either. A given expertise may offer an ambiguous reading of or be unable to resolve the uncertainty in a situation. In such circumstances, the other forms of expertise may help **negotiate** that ambiguity. In the story focused on drilling the floor and cutting the concrete wall, actors drew on embodied and interpersonal expertise to manage the contradictions in the arcane and the ambiguities in the technical. Arcane expertise offered competing courses (drill and do not drill), and the technical

expertise in the situation could not identify with certainty the location of the post-tension cables. The contractor was able to feel for the cables by virtue of embodied expertise gained through experience with the impact drill. The embodied expertise allowed the contractors to act despite the uncertainty of the location of the cables. Research informed by a conceptualization of expertise heterogeneity should consider how expertise forms work in concert to negotiate uncertain or ambiguous situations to enable action.

Expertise may clarify in that sense, but a particular form of expertise may also **obscure** alternative meanings. That is, a particular aspect of expertise may be so salient that others are not considered or not understood as relevant. As the inspector walked down the boards, he expressed concern that instead of amplifying his awareness of the state of the plant, his embodied expertise might obscure a technical reading of the panels and indicators.

Future research focused on how expertise may obscure should be of particular interest in studies of embodied expertise. In the study of knowledge work, concern for technical, arcane, and interpersonal forms of expertise have overshadowed embodied expertise (Collins, 2011; Gherardi & Nicolini, 2002). All work involves a material, physical understanding of the confluence of bodies, the situation, and what is or is not possible (Sennett, 2009). The embodied character of expertise is particularly clear in the trades and craft work, where capacity to act typically involves body work. Embodied expertise may be the most easily obscured, because it is vested not in the mind of the surgeon but in her hands, not in the argumentation of the attorney but in his eye for the face of a confused client, not in the rolodex of the public relations professional but in his ear for the tone of a conversation, not in the technical specifications of the engineer but in her feel for a building in progress. The taxonomy should be useful for future

research in part as a tool for revealing expertise that may otherwise be obscured or unapparent even to those who wield it.

In sum, the taxonomy offers a framework for considering how expertise amplifies, contradicts, negotiates, and obscures expertise. The interaction among these forms of expertise center on the differing authority conferred by expertise, authority tied to systems of understanding, to macromorphic structures, to "thirdness." Taylor and Van Every (2014) argued for the importance of expertise negotiation in organizing itself, "The thirdness has been translated into a property, not of individuals, or pairs of individuals, or even of groups, but of the community as a whole. It is a system" (p. 197). A key implication of the systemic, macromorphic character of expertise (see Fulk, this volume) is that these different forms of expertise not just vested in the individual but in organizational and institutional structures. Though it may be useful to conflate particular experts with expertise (e.g., common in studies of particular professions, Barbour & Lammers, 2015), research concerned with expertise heterogeneity should not do so. Instead, the taxonomy prompts us to ask how, for example, engineering *and* crafting are technical and embodied, arcane and interpersonal.

Relational Expertise

A focus on interaction among these forms of expertise may also enrich theorizing in this domain, by nuancing a key insight of communicative approaches to expertise: That it is constructed and judged in relationships (Huang et al., 2013; Ren & Argote, 2011). The taxonomy underscores that expertise is also relational in the sense that our expertise can focus on the interpersonal. Relationships *themselves* and the history and tenor of relationships involved in problematic situations are the subject of expertise. Expertise is *in* and *about* relationships. Research should consider not only the relational negotiation of expertise, but also relationships

as an object of expertise. Research could consider for example, how generating technical, arcane, and embodied expertise produces concomitant interpersonal expertise.

Expertise Coordination

The taxonomy also speaks to another key question in the communicative study of expertise and knowledge work. Scholars and practitioners have an overriding concern for understanding how expertise coordination systems work and how to make them work more effectively (e.g., more creatively, more quickly, Hollingshead & Brandon, 2003). The material and discursive maps of expertise, of who knows who knows what, form differently (e.g., experience, word of mouth, credentials, role). Additional research should consider how different forms of expertise complicate the creation and use of material and discursive maps of expertise. For example, expertise is attended to differently—it is salient in different ways. The forms of expertise in the taxonomy look different in practice. They involve different tools. Teams may specialize not only by knowledge domain, but also expertise form. These forms involve different trust criteria, and they are coordinated differently. Interaction among expertise forms may generate new knowledge as well when, for example, the clarification of ambiguous problematic situations creates a new useful knowledge for action (Kuhn & Jackson, 2008).

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Conclusion

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Although our conceptualization of expertise and knowledge encompasses more than the attributes of an individual, it is nonetheless focused on how individuals use what they know. How that something differs is the key to our taxonomy, but expertise is still herein something mobilized by the individual. Expertise is not just an attribute, but it is a capacity for action—a capacity that reflects different authority, and therefore different legitimacy criteria and different encumbering. Therefore, we locate expertise in the action of those individuals—not a

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characteristic but a socially constructed, shared sense of what the expert can or cannot do. Expertise and communication are related in that experts employ and develop different forms of what they know in and through communication. Expertise is organizational in the sense that it is embedded in networks of relationships emergent in organizing (see Fulk, this volume), and it is extra organizational in that expertise authority depends not just on the understandings of the local others' judgments about the expert. Experts draw legitimacy, their capacity to encumber others, and their authority from sources in and outside the organization.

Recognizing these distinctions is essential in the face of the profound technological change that characterize (post)modern life. Taylor and Van Every (2014) argued "changes in technology necessitate a rethinking of management practice: literally how to organize—and how to establish authority in the new assemblies of organizing" (p. 199). The stories above demonstrated the fundamental entwining of technology (broadly defined) and expertise, including how the very technologies designed and utilized by experts can ultimately undermine and subvert knowledge. Understanding technological change therefore necessitates understanding how knowledge, knowing, and expertise are bound up in and by technologies (Sennett, 2009). Importantly, our taxonomy of expertise and knowledge work focuses analysis on expertise heterogeneity, recognizing that expertise operates in nuanced ways in the relationship between technology and organization. The taxonomy, in particular, illuminates diverse resources for accomplishing knowledge work, incorporates varying relational dynamics, and complicates expertise coordination in necessary ways.

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Table 1

Expertise Forms

	Knowledge Work	Legitimacy	Encumbering	Authority
	"The performance centers on the	**"I judge the performance as legitimate when it…"**	**"The performance encumbers me because it…"**	**"The performance draws force from…**
Technical	Technical properties of the work	Accurately and correctly yields facts or solutions	Names	Professional acumen, formal education, apprenticeship
Arcane	Policies, standards, and laws that govern the work	Provides a convincing reading per existing conventions	Adjudicates	Law, policy, professional standards
Interpersonal	People involved in the work, relational history of the work	Captures who we are together	Connects	Participation relationships
Embodied	Physical conduct of the work and the arrangement of the work space	Reads the wisdom in space / material conditions / time with insight	Sees	Consequences of material conditions of work