The Cultural Power of Tacit Knowledge: Inarticulacy and Bourdieu's Habitus

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Running Title: Power of Tacit Knowledge

Abstract.

Tacit knowledge is knowledge of practices or a logic of action whose inarticulacy allows it both to be taken for granted and to escape discursive constraints. Since Pierre Bourdieu treats the habitus as a taken for granted set of predispositions and logics of practice, we can understand it better by learning more about tacit knowledge. To that end, I will describe Polanyi's concept of tacit knowledge, and employ Deleuze on repetition and "figured world theory" on imagination in learning to expand our understanding of tacit knowledge and its inarticulacy. I will illustrate how tacit knowledge works with a close reading of a 17th-century book for stonemasons which teaches a new practice of construction for realizing classically-inspired architecture as it became fashionable. Using pictures rather than words, the book

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presents a way to imagine stones and arches as plastic and flexible, illustrating the strong connection between tacit knowledge to cultural imaginaries. Applying this understanding of tacit knowledge to the habitus reveals this inarticulate cultural domain to be not simply a mechanical tool of social reproduction, but a malleable formation of collective imagination, a trickster that can shape logics of practice outside discursive common sense.

Tacit knowledge, or knowledge that is inarticulate or unarticulated, lies at the heart of all cultural life, and is exercised in dull and repetitive activities that constitute the heart of daily existence. It seems without much character or importance, but that is precisely why tacit knowledge can be the unruly trickster in culture. Inarticulate actions based on tacit understandings of cultural possibilities can bypass discursive reality, trouble cultural categories and elaborate cultural imaginaries that are not captured in words. It is knowledge that is never quite enough, always addressing emergent problems that are not finally solved but worked around. We know from the social construction of reality (Berger and Luckmann, 1967) that social actions are not set in stone and can be transformative, but we also know from Foucault (1977, 1978) that thought can be constrained within regimes of discursive commonsense. Inarticulate repetitive actions that on the surface seem mindless can actually facilitate shifts in culture by following their own material logics and imaginaries beyond discursive common sense, becoming what Deleuze (1994) calls repetitions that make a difference. Improvisatory social activity can provide escape routes from discursive regimes and make possible new social constructions of reality. The routine breakdowns and absurdities of mute, everyday cultural practices, demonstrating the limits of commonsense, can encourage people to improvise new actions that break with recognized discourse (like the Occupy movement or Arab

Spring). Participants respond to political ideas that feel wrong or dishonest by exploring practices of participation that feel right.

Thinking of inarticulacy and its role in cultural life is particularly useful for engaging with Bourdieu's work on cultural reproduction (Bourdieu, 1984), and for understanding the importance and limits of Bourdieu's concept of habitus. He treats unarticulated tastes as products of the habitus, but only points to their role in the reproduction of social class without reflecting on the distinctive cultural power of inarticulacy. But as Deleuze (1994) suggests, inarticulate repetitions can make a difference (be innovative) both culturally and politically because they work outside discursive common sense. They can help to weave new cultural imaginaries about social identities and practices, suggesting that the habitus has a potential for silent subversiveness as well as cultural reproduction.

Bourdieu's concept of habitus has been useful for approaching cognitive forms of cultural power (Brubaker, 1985; Lizardo and Strand, 2010; Sewell, 1992;Wacquant, 2011). But habitus has also been a hard term for many social analysts to use because it seems vague and incomplete. What is a cognitive predisposition or a cultural logic? The question can be answered more precisely by focusing on the inarticulacy of cultural predispositions and logics as forms of tacit knowledge, and by understanding their connections to cultural imaginaries that animate practices (Anderson, 1983) Cultural logics of

practice are not asserted or defended like language-based logics. They are acted upon or not-- entertained as usable, or rejected as unlikely or untenable.

Practices of the habitus, as inarticulate cultural actions, shape power outside debate. This often results in social reproduction, as Bourdieu suggests, but the same inarticulacy can give logics of practice powers that Bourdieu does not appreciate or even recognize. Radical social change can begin with what are called leaps of faith -- acts of refusal that "make no sense" politically like setting up protest encampments. They are "logical" only as practices based on tacit knowledge of what is possible to do and shared cultural imaginaries about what should be done--dreams of possibility that lie outside political discourse.

Polanyi and Tacit Knowledge.

To make better sense of the inarticulate power of tacit knowledge and relate it to cognitive formation in the habitus (Lizardo and Strand, 2010; Mische, 2012; Swartz, 1997), I will begin with Michael Polanyi's concept of tacit knowledge, his description of its inarticulacy and its connection to practices. Polanyi, a philosopher of science interested in explaining what is learned through experiments, defines tacit knowledge as the intuitive sense of what to do in research based on experience with natural phenomena. He contrasts it to formal

knowledge or conceptual knowledge based on reasoning from explicit propositions.

> Philosophers [of science] have not done justice to the distinction which is quite familiar to all of us between knowing that something is the case and knowing how to do things. In their theories of knowledge they concentrate on the discovery of truths or facts, and they either ignore the discovery of ways and methods of doing things or else they try to reduce it to the discovery of facts. They assume that intelligence equates with the contemplation of propositions and is exhausted in this contemplation. (Peck, 2008: 111)

Formal knowledge, according to Polanyi, describes what is in the world; it consists of representations that are judged by their accuracy. Tacit knowledge addresses how to act in the world with things.Tacit knowledge often consists of a series of steps in a material process and it is validated by demonstrations that the activities "work." Tacit knowledge is about sequences, practices, and transformation-- not stabilized truths, but changing logics about what could be done next. Tacit knowledge as described by Polanyi appears to be comparable to the logics of practice in the habitus as described by Bourdieu. So,

Polanyi's descriptions of the distinctiveness of tacit knowledge can give us a new understanding of the habitus.

Polanyi argues that tacit knowledge is a creative rather than conservative force in science. Scientific researchers doing experiments routinely encounter natural forces and properties that they cannot name, much less theorize precisely. In the face of this, they develop informal conceptions of the patterns in experimental results and use them as guides for designing their next experiments. Over time, they build up an inarticulate understanding of the natural properties or forces that they study. If they can, Polanyi argues, researchers try to articulate these patterns to make them formal knowledge. So, in Polanyi's model, tacit knowledge is an engine of creativity in science that works through practices, but can change formal ideas.

Historians of science, following Polanyi, have documented not only how important tacit knowledge has been to the Western experimental tradition in science (Roberts, Schaffer, and Dear, 2007; Shapin and Schaffer, 1985; Smith, 2004; Smith, 2011), but also how it developed from artisanal traditions of material practice that were intentionally inarticulate (Biagioli, 2006). To protect their trades, artisans kept their techniques secret, only writing down simple recipes or recording them in codes that outsiders could not read. Cities enforced artisanal secrecy, too, since tacit knowledge of a valuable trade was important to the local economy -- as glassmaking was to

Venice (Biagioli, 2006). Artisans taught the tricks of their trades by apprenticeship and learned by experience from engaging in repetitive material tasks.

The result was a system of tacit knowledge that was explicitly kept inarticulate and a pattern of cultural reproduction of social rank through the habitus of artisans. The invisible technicians described by Steve Shapin (1989) and the women researchers described by Schiebinger (1989) were heirs to this system, becoming the inarticulate servants and helpmates of the gentlemen who articulated modern science (Smith, 2011, 2004; Mukerji, 1997; Oreskes, 1996). Tacit knowledge could serve successfully as the foundation for both social reproduction and evolving competences (cf. Sewell, 2010) precisely because it was kept inarticulate (Henderson, 1991; Turnbull, 2000: Mukerji, 2009)).

Tacit knowledge, as David Turnbull (2000) argues, is often treated as mindless and insipid because it takes cookbook forms. Its inarticulacy is assumed to reveal a cognitive insufficiency rather than to point to deep skills assumed in the recipe. Nonetheless, tacit knowledge has been explicitly cultivated, too, for practices in which articulation can hinder action. Sudnow (1978), for example, has described in nice detail about how pianists practice scales and piano pieces to make their hand movements automatic, so they can improvise without thinking about their hands or the scores. Suchman

(1978) also describes how office workers develop rhythms and techniques of playing with copiers and other office technology to increase efficiency. And Henderson (1999) explains how engineers draw over problematic blueprints, illustrating possible changes to a design without having to articulate what is wrong. In all these cases, people want to take their skills for granted. They may develop these skills at first using recipes, design protocols, sheet music, rules of the road, and standards, but they teach their eyes and hands through experience to move automatically, so they can improvise their performances of cultural practices. Tacit knowledge in this sense is a form of competence created through repetitive practices that teach an inarticulate logic of action used in improvisatory ways.

Repetition and Difference in Deleuze.

To look at the political implications of repetitive practices both for understanding the habitus (Mische, 2012; Swartz, 1997; Wacquant, 2006) and for elaborating the concept of tacit knowledge, I will turn to Deleuze on repetition and difference. He describes the creative potential of inarticulate, repetitive action as a means of evading discursive commonsense and fashioning new cultural logics (Deleuze, 1994). Deleuze cites Hume, saying, "Hume... implies, in principle, a perfect independence on the part of each presentation." (Deleuze, 1994:70) Repetitive actions reveal differences across iterations that

destabilize the boundaries of the classification systems that define commonsense differences. Things that are supposed to be the same are not exactly, and this problematizes the power of language (Peck, 2008). Repetitive practices have their own existence that becomes more evident as the power of language attenuates. Deleuze says: "Repetition thus appears as difference without a concept.... It expresses a power peculiar to the existent, a stubborness of the existent in intuition, which resists every specification by concepts no matter how far this is taken." (Deleuze, 1994:13-14)

For Deleuze, "common sense" is what everyone "says" about the world and action in it, bearing no necessary connection to experience. Most of the time, people will try to reconcile what they hear in language with what they experience. But they can alternately simply try to do things that make practical sense to them even when these activities are considered culturally illegible or unspeakable. Their practices, if successful, can in this way force a change in linguistic commonsense.

This radical potential of inarticulate practices has implications for the habitus that are unthinkable (unspeakable?) to Bourdieu. The habitus is something to escape, not an escape route. But Deleuze shows that repetitive practices that follow a logical sequence can still shift the ground of a culture. So, the habitus may not be just a

mechanical tool of social reproduction, but also a place to escape discursive commonsense.

Figured World Theory.

To think more about tacit knowledge, the cognitive predispositions of the habitus, and their cultural power (Brubaker, 1985; Lamont 2000; Lizardo, 2004; Wacquant, 2006), I will now turn to figured world theory (Holland, Lachicotte, Skinner, and Cain, 1998). Figured world theory is an activity theory of learning that treats cognitive development as a cultural practice as well as a mental one, and describes cultural performances as pedagogical activities that teach cultural predispositions in thought and skill through inarticulate action.

I treat the habitus as a figured world, justifying it in part because both theories are importantly derived from the work of Jean Piaget (1959) and his ideas of learning by doing. Piaget treats cognitive development as a product of activity that leads to the acquisition of age-appropriate schemas; Bourdieu picks up the same idea to explain how cultural practices teach (Lizardo, 2004). Figured world theory simply asserts that learning is primarily a cultural process of socialization rather than a biological process of acquiring human mental attributes. Figured world theory is derived from the sociocultural psychology of Vygotsky (1978): a Marxist theory of mind

and learning. He argues that cultures imbue members with predispositions that are political, historical, and transformative. Education, like everything else, is politically inflected and culturally played out. In this sense, figured world theory is completely consistent with what Bourdieu argues.

Vygotsky, like Piaget (1959), contends that learning begins with concrete experience, not abstract thought. He contends that people can learn even abstract reasoning by generalizing from particular experiences. But Vygotsky emphasizes that children learn from manipulating cultural artifacts so in addition to acquiring abstract abilities to think, they absorb the assumptions of their culture. They learn logics of practice that sustain the social order, or in Bourdieu's terms, they become immersed in a habitus.

Figured world theory is a good tool not only for explaining how people become absorbed in a habitus, but also to consider different implications of this type of cultural learning. Drawing on studies of situated action (Lave, 1988; Lave, 1993; Suchman, 1987) as well as Vygotsky, figure world theory argues that people improvise cultural life within ecologies of material and cognitive artifacts. What they do and think they can do is supported and circumscribed by these cultural tools that help shape what they imagine to be possible. But learning cultural skills by heart, they also explore the creative potential of the skills they learn from their habitus or figured world.

Most importantly for rethinking the habitus, the logics of practice within figured worlds are shaped by cultural imaginaries. In emphasizing imagination, the theory builds on anthropological understandings of the power of myths and stories to give coherence to social life. But rather than serving as constraints on figured worlds, cultural imaginaries simply provide goals and logics for improvised action, making figured worlds at once pedagogical, playful, thoughtful, creative, destructive and innovative (Holland, Lachicotte, Skinner, and Cain, 1998). Like Polanyi's researchers, children in figured worlds imagine who they are, what other people are doing, what the world is like, what there is to do in life, and what would be good to do next. They acquire logics of practice from watching and imitating others, learning through unarticulated patterns of apprenticeship -- even in the classroom. Most of the time, people act “as if” their social imaginings are real, coordinating their actions to fit their dreams and turning fantasies into material and social forms. But experiments with performances and artifacts can stimulate the development of new imaginaries, using repetitions to "make a difference" by scaffolding shifts in cultural imaginaries (Adams, 2009; Holland, Lachicotte, Skinner, and Cain, 1998).

If we expand the concept of the habitus to treat it as a figured world, we can see its cognitive predispositions and logics of practice organized around cultural imaginaries, and scaffolded by artifacts and

scripts for social performances meant to realize those shared dreams. The habitus may be naturalized and social relations reproduced because people take the cultural imaginaries as real and beyong debate. But if the habitus is a figured world designed to realize cultural imaginaries, then the habitus could turn into a trickster, shifting what is imagined to be possible by experimenting with practices.

The Case Study.

To explain better how tacit knowledge works, and how it gains power through inarticulate repetition and the reconfiguration of cultural imaginaries, I will do a close reading of a 17th-century book on technical drawing for masons, authored by an engraver, Abraham Bosse: La pratique du trait a prevues, de Mr Desargues, lyonnois, pour la coupe des pierres en l'architecture (Desargues and Bosse, 1643). Bosse's book uses projective geometry to address a problem in French stonecutting that developed when French nobles gained a taste for Italianate architecture. François I brought humanist ideas, Italian tastes and artists like Leonardo da Vinci to his residence in the Loire Valley, and stimulated both intellectual ferment and a boom in local construction of Italianate châteaux. Unfortunately for French masons, they were ill prepared to build what the nobility desired. The new stately residences not only broke with medieval aesthetics and architectural engineering (Bresc-Bautier, 2008; King, 2000; Melot,

Saudan, and Saudan-Skira, 1988), but also confronted masons with unfamiliar construction problems.

If Holsinger (1988) is correct that Bourdieu developed the concept of the habitus from Panofsky's book on gothic architecture and scholasticism, this moment of transition away from gothic to baroque architecture should be particularly revealing of how the habitus can change. Panofsky (1957) argued that design elements of gothic cathedrals were logically parallel to forms of scholastic reasoning, connecting medieval intellectual life to patterns of problem solving in practical life. So, changing architectural styles entailed the cultivation of a new figured world of practice.

Bosse's book gives us evidence of how artisans tried to handle this transitional moment. It documents the search for new practices of stone cutting to fit humanist logics of design, explicitly focusing on tacit knowledge or unspoken logics of practice. By addressing the tacit knowledge of artisans exclusively, refusing to formalize the logic of practice he wanted to teach, Bosse shows how deeply building methods were connected to forms of cultural imagination that served the gothic moment, but now limited the ability of artisans to engage with the new styles.

Masons had relied for centuries on a set repertoire of building techniques and templates for making standard parts of gothic buildings according to codified methods, forms and standards that fit a culture of

ritual practice and spiritual yearning for perfection (Turnbull, 2000; Scott, 2003). Asked to build Italianate villas, stonecutters and masons had to experiment with methods for putting stones together to make viable structures in the desired shapes. They could work with materials and templates as they had done before, but they needed a way to make templates. While French architects in the period had manuscript versions of Vitruvius (Vitruvius and Perrault, 1673) to read to help them think about classical proportions and aesthetics, there was no comparable set of documents for stonecutters, teaching classical means of construction. The figured world of classical architecture was gone, so the artisans could not learn by apprenticeship. Instead, the engraver and author of La Pratique, Abraham Bosse, created a virtual world of classical practice, an invented tradition, using geometry based on classical principles as a basis for technical drawings of templates for stones.

Bosse used the projective geometry of Gérard Desargues, but translated the mathematical knowledge into a drawing practice that artisans could learn by doing. The key to stone cutting in La Pratique was the "proving line" -- what in geometry was called a Desargues line-- that could be used as a tool for technical drawing to determine the form of stone templates for arches. He presented techniques for making and using proving lines in a series of "how-to" illustrations, never explaining the geometrical reasoning behind the methods of

drawing he prescribed (McTighe, 1998). Bosse simply used virtual apprenticeship to constitute and convey a new figured world of stone cutting.

Bosse's images in La pratique du trait a prevues taught an imaginative practice of recursive material action, a difference to make a difference. His pictures were not blueprints of desired buildings or engineering plans (Harrison and Johnson, 2009; Jasanoff and Kim, 2009); they illustrated a recipe or series of steps in a practice of drawing. Bosse treated tacit knowledge as similar to what Ansel Adams has described as previsualization in photography (Adams and Baker, 1980). He did not convey an exact plan, but a way of anticipating outcomes to shape material practices in process. In this sense, Bosse taught ways of imagining what to do rather than articulating why it worked (Dominquez-Rubio and Silva, 2013; Dominquez-Rubio, 2014; Jensen and Rödje, 2010; Peck, 2008). He showed how to conceptually "fold" the world in new ways (Bowker, 2010) so it could be constructed and inhabited differently.

Bosse was a master engraver with the pictorial skills and interests to teach Desargues' mathematical techniques (McTighe, 1998). He published a number of highly illustrated "how-to" books based on Desargues' geometry, including one on linear perspective and another on methods for setting sundials in gardens (Bosse, 1645; Bosse, Join-Lambert, Préaud, Bibliothèque nationale de France, and

Musée des beaux-arts de Tours, 2004; Desargues and Bosse, 1647). He also documented and celebrated the tacit knowledge of artisans in a series of prints on practices of the different trades (Bosse, 1645). He clearly thought that artisans had special knowledge, and he took for granted that it was inarticulate and depended on careful manual training tied to vision and other senses. Bosse became so famous for his geometrical skills that he was contracted to teach linear perspective at the *Académie de Peinture et Sculpture* before being expelled in the 1660s during Le Brun's take over of the institution (Bosse et al., 2004; Cojannot-Le Blanc, 2004; Goldstein, 2012). By that time, Bosse had already published extensively on Desargues' methods, illustrating the range of their uses.

Bosse could have presented projective geometry as a form of formal mathematics. Gérard Desargues was a scholar of classical conics who corresponded with both Marin Mersenne, the monk who stood at the center of French mathematics, and René Descartes. Descartes praised Desargues' proof, but scolded Desargues for abandoning terms from classical conics to make his geometry comprehensible to artisans. Desargues had started a school for artisans in the 1640s that Bosse attended. (Desargues and Poudra, 1864; Field and Gray, 1987: 28, 176-177). Desargues left mathematics and became an architect to "prove" his mathematics, training masons to use his methods (Field and Gray, 1987).

There were cultural reasons why Desargues was interested in logistical demonstrations of his mathematics (cf. Rosental, 2004; 2008). It was part of his habitus. The classical scholar lived in a part of France filled with Roman and Greek ruins, and like other classicists of the late French Renaissance and early Baroque (Miller, 2000), he saw evidence of the mathematical brilliance of the classical world in its material forms (Gébara, 2001). He identified Rome as a culture of engineers, architects, and mathematicians who all had interests in the genesis of forms. Desargues immersed himself in this tradition, and dedicated his life to contributing to it both conceptually and materially (Desargues and Poudra, 1864; Field and Gray, 1987).

Bosse used Desargues' geometry to shift the cultural logic or habitus of the French building trades, creating an imaginative break with gothic understandings of stones and arches to engage artisans with a new imaginary. In Bosse's illustrations, arches lost their stoniness and were turned into planar geometrical figures, rising from the ground and rotating around lines like pages of a book around a spine. Learning the technique did not introduce readers to a new discursive or formal reality, but rather drew them into a new "figured world" of imaginative practice (Holland, Lachicotte, Skinner, and Cain, 1998) in which arches could be treated as planes more than curves, and rock faces could be imagined as flat forms on paper. The illustrator took readers on a voyage outside of common sense to teach skills as

part of an unarticulated cultural imaginary. The book created a virtual habitus in which to reimagine building practices in order to help artisans recognize how to build structures that had seemed impossible before.

Desargues Theorem.

Before analyzing La Pratique du trait à preuves ... pour la coupe des pierres en l'architecture (Desargues and Bosse, 1643), I will say a few words about Desargues' projective geometry for those who would like to understand it. It is not necessary to understand the theorem to read the rest of this paper, since Bosse himself did not teach it. But for those are accustomed to thinking about geometrical proofs, seeing it can be useful. And the idea is relatively simple even though this is pre-Cartesian mathematics.

Figure 1: Desargues' Theorem

According to Desargues' theorem, if a figure from one plane is projected onto another plane, lines extending from the figures on both planes meet at points along a single line: a Desargues line. So, in figure 1, the triangle ABC on plane AFG is "projected" from point D onto the plane A'FG to create the triangle A'B'C'. Lines from these triangles are extended onto line EFG. EFG is the Desargues' line, or

"proving" line in Bosse's book. This line serves as a "hinge" between planes, and can be used as a custom measuring stick for relating figures across these planes. The points on the proving line can be used to draw comparable figures on any other planes rotating around that line. In this way, a Desargues line can be a tool for drawing related shapes on different planes, such as the radiating joints in arches.

The geometry is pre-Cartesian, so the figure does not use coordinates, angles, or measures. This makes the proving line a "measuring" tool without metrics. The relations between the figures are proportional, but so were the terms for measures used in the building trades in the 17th century. Bosse assumed his readers could understand proportional concepts, and worried more about conveying the three dimensional aspects of the geometry (Desargues and Poudra, 1864), helping his readers move between 3D and 2D imaginaries.

Problems of Construction as Problems of Geometry.

The Pratique had three parts: 1) an introduction, explaining how Bosse wanted to teach projective geometry as a form of technical drawing and the basic terms he would use for describing the process; 2) the twelve step method (or "recipe") for developing proving lines for arches; and 3) methods for using proving lines to make templates for fitting stones for arches (Desargues and Bosse, 1643: 1-3). The "table of contents" consisted of a list of 103 plates, illustrating steps in the

practice, each of which was followed by short commentary pointing to significant details in the prints.

The text of the Pratique articulated only a seemingly mindless set of directions, and was devoid of explanations of the steps involved. By omitting the mathematical reasoning behind the practice, Bosse's book seemed to avoid conveying knowledge. But the illustrations depicted with exquisite detail the skill involved in the practice, and how to reconceive arches and stones as planar.

In the introduction, Bosse specified that his purpose in writing the book was to improve artisanal practices, not abandon tradition. "Concerning hand-made works of art, if you want to understand them to their foundations, there are three things to distinguish: what you have to do, the means for doing it, and knowing how to do it effectively." (Desargues and Bosse, 1643: 2) He argued that projective geometry could help refine the third part of the practice: teaching his readers how to do better what they already knew how to do with conventional practices --use templates to cut stones to fit arches.

Bosse made a tripartite distinction among forms of knowledge, too. He said that it was quite different to know how to invent a geometrical proof (formal knowledge), understand the method well enough to teach it (translate from formal to tacit knowledge), and learn how to put that method to work in practice (tacit knowledge). Desargues could invent a new form of mathematics; Bosse could teach

it to artisans; and readers who learned the practice could use it to solve problems in architecture. Using the term, "knowledge," to designate tacit knowledge, and distinguishing it from "intelligence" or formal knowledge, Bosse told his readers that he would teach "knowledge" without requiring "intelligence." He went on to say that Desargues (who had intelligence) knew nothing about working with his hands, or about aesthetics or good taste. So, Desargues had nothing (no knowledge) to teach artisans about what was good to build or how to build it well. The mathematician had simply invented a mathematical procedure that could help them do their work better (Desargues and Bosse, 1643: 1-4): a tool for creating custom templates for construction.

Bosse not only sounded like a Polanyi scholar, distinguishing between tacit and formal knowledge, but he also sounded like a scholar trained in figured world theory in distinguishing between rules of practice (instructions), and theories about rules of practice (practical imaginaries). To teach his technique for making templates, he said he would present his readers with rules of practice (instructions), leaving his readers to produce their own theories about the practices he presented (imagining why those instructions worked). This was a classical Vygotskian approach to education. Bosse taught by experience, not by explanation (Desargues and Bosse, 1643: 4), and

he even argued there was danger in trying to articulate experiential knowledge:

> [W]hat comes from testimony can be faulty. [But] what comes from [practical] knowledge is infallible, or if you wish, just and precise.... [I]t requires practice and the long exercise of the hand.... The execution lives below the level of [reasoned] intelligence, and one cannot learn it from a distance (Desargues and Bosse, 1643: 2).

Bosse told readers not to "read" his book for information, but rather follow the instructions to learn from experience (treating the sequence of drawing practices like a musical score to practice and learn by heart). He also made the prints realistic to carry the burden of educating the reader. As he put it:

> The illustrations that are drawn in close-to perspective, as you have in all this book, explain themselves well enough on their own in my estimation, with the few words that are printed around them, so that you can decipher them down to the smallest part of what they represent. I did not however neglect to speak of them to you; but I have made [the pictures] primary to show you by eye where I could each thing that I wanted to

> convey to you about the old manner of cutting stones for architecture and the new manner of doing it (Desargues and Bosse, 1643: 60).

Although Bosse disparaged articulation as a means for learning a practice, he still needed language to point to elements of his pictures, so in the introduction, he also created a special glossary that would help him carry his readers outside discursive commonsense. Bosse said that in architecture, there are two common manners of talking, one about theories of design and one about construction. The theoretical tradition described principles of proportion from which to design buildings, and the tradition of practice explained the steps needed to realize a design. But Bosse added that there was a third (uncommon) way to talk about architecture with the language of geometers, making and interpreting figures drawn on paper; this was the approach of M. Desargues (Desargues and Bosse, 1643: 9). Projective geometry provided a means of escaping two traditions of discursive common sense, allowing readers to rethink their practices by using only Desargues' vocabulary for projective geometry in addition to Bosse's illustrations (Desargues and Bosse, 1643: 7-9, 14-16, 29-30).

The most important term in Desargues' vocabulary, according to Bosse, was the plane. The geometrical term, he cautioned, did not

have the same meaning as the commonsense one. A plane was a flat expanse that could be level or tilted at an angle. The term referred to something like the plan (or map) of a village. But planes were not necessarily horizontal; they could be vertical or slanted like the side of a wall or the face of a stone. Bosse explained that as Desargues used the term, plane, he meant something that was universal, in other words, a form that could be used to describe many things, such as walls, doors, the plan of a village or sloping ground-- all of which were flat. Defined this way, a plane was not a specific element in architecture, but a characteristic of many parts of a building or building sites. (Desargues and Bosse, 1643: 7-8).

Finally, Bosse assured readers that his techniques, although requiring new vocabulary, were not so hard to learn. The engraver said he would go "back and forth" between traditional ways of cutting stones, and geometrical operations in order to teach the new method (Desargues and Bosse, 1643: 25-52). In this way, he promised to help his readers to enter a different world of cultural imagination.

Bridging Imaginaries with Pictures.

Bosse tried to bridge the commonsense world of the building trades and the world of geometry by using naturalism to represent traditional problems of construction and superimposing geometry to

analyze the forms. He began with familiar types of stone structures made with arches (figure 2).

Figure 2: Analyzing Arched Structures

By depicting three different arched forms, Bosse established the kinds of structures he wanted to address with his method, and by superimposing geometrical lines on naturalistic forms, he pointed to the kinds of forms he wanted his readers to learn to draw. He even showed "proving lines" (EE) penetrating all three structures to give readers a sense of what they might be and their importance to the arch.

Bosse also illustrated the terms from his glossary using a generic, geometrical arch (figure 3), depicting it as an empty form rather than a stone structure. He used the picture to make the counterintuitive point that the surfaces in the arches were mostly planar, not curved, and even the curved surfaces of the wedges at the top of the arch could have flat surfaces and still be structurally sound.

Figure 3: A Geometrical Arch

Bosse labeled the relevant planes in the geometrical arch with Desargues' terms: the plane along the front of the arch that described the sideways tilt of the ground (*alignment au niveau*), the upward or

downward slope through the arch (*route nivelée*), the plane across the top of the pillars on which the arch was to be built (*face nivelée*), and the backward or forward slop of the face of the arch (*face eslevée*).[1] Bosse even depicted the interior and exterior surfaces of one of the wedges in the arch (*doele*) as planes rather than curves, showing that the arches could be completely planar in his imaginary portal.

In later illustrations, Bosse returned to the simple arch, but made it a stone doorway. Using naturalistic imagery, he depicted masons approaching this hypothetical stone doorway with traditional measuring tools in hand (figure 4). The artisans were imagining a door they wanted to build, and thinking about how to build it with their tools.

Figure 4: A Hypothetical Stone Doorway

The stone doorway, in this naturalistic form, referenced the commonsense cultural imaginary of traditional masons. It included stones, tools and sites, and used anticipatory imagination as a foundation for tacit knowledge. But Bosse also superimposed onto this image of practice a secondary geometrical imaginary, connecting measuring tools to dotted lines marked with letters. He suggested that constructing stone arches already entailed making measures of imaginary structures. Now masons could use the measures to draw

templates, using a geometrical form of imagination. In this way, Bosse went "back and forth" between traditional practices and geometrical drawing, superimposing two ways of imagining arches.

After equating the practices of measurement, Bosse began to separate the practice of cutting stone from technical drawing for templates (figure 5).

Figure 5: Measuring Stones vs. Drawing Lines

At the top of the illustration, he depicted masons' measuring tools applied to a block of stone, and next to it, a stone that had been shaped to fit the measures. This drawing was naturalistic, referencing the taken for granted figured world of stone cutting practices. At the bottom, he placed the tools on paper to make technical drawings from the angles, referencing a geometrical figured world in which stones could be reduced to 2D shapes: Bosse's imagined world of technical drawing. In this way, Bosse highlighted the difference between the commonsense cultural imaginary of masons and the geometer's figured world of lines and planes. Bosse's stone doorway was a portal between conceptual universes. Stepping through it by following his directions, artisans who knew nothing of formal mathematics could still make "proving lines," and use them to draw custom templates for a building project.

A Twelve Step Method for Making Proving Lines.

The "recipe" for the new practice began with eleven steps or "operations" for computing proving lines. Bosse took the tools and measures from the imaginary stone arch (figure 4), and put them on paper (figure 6), starting the series of "operations" or drawing activities that yielded proving lines.

Fig. 6: Generating Lines from Tools

He labeled the tools and lines with Desargues' terms, drawing his reader further into his cultural imaginary of technical drawing. Masons who followed the practice, trying to reproduce the operations, were not only separated from their habitual ways of imagining their practice, but also their linguistic traditions. The lines referred to things in the world, but they were alienated from their cultural moorings.

It took eight operations for Bosse to get to the first proving line (line SS between A and H in figure 7). To indicate that SS was a not just a line but a tool, he depicted it as a stick or straight edge --similar to the other measuring tools used by artisans. By the eleventh operation, Bosse had drawn a second proving line, EE, extending from A and parallel to G, again representing it as a straight edge or measuring stick.

Figure 7: Proving Lines as Measuring Sticks

These measuring sticks were the last remnants of the commonsense world of masons that Bosse used to teach his method. At the end of "operations," the tools disappeared from Bosse's illustrations, and geometry took over. Now, the problem was to draw templates, and this was a matter of determining the shapes from the proving lines, not a matter of using tools to make measures and draw forms.

Proving lines and templates

In the third section of La Pratique, Bosse abandoned naturalism and set his readers firmly inside a new figured world of geometrical practice as he showed them how to mark proving lines to describe the arches they wanted to build, and draw templates from the proving lines to cut stones precisely to fit those arches. The solidity of stone and the inflexibility of tools disappeared, so planes for arches no longer had to be set into standard forms and relations. They rotated around proving lines, and expanded to define sets of joints for an arch. They were moved, reconfigured, and folded into figures resembling blocks. Finally, they became templates in a workshop, where paper figures and stone blocks met again, but under new circumstances.

Figure. 8: Using Proving Lines to Generate Templates

All the faces of stone in the arch could be treated as figures on a plane (figure 8). But their shapes varied depending on their relationship to the slope of the ground, the tilt of the wall, the turn of the arch or slope of the ceiling. These differences could be documented and generated with points on proving lines, and Bosse illustrated this point by showing templates revolving around a proving line which they all shared. And since the lengths of the faces on adjacent stone had to match, they shared a common dimension. So, Bosse rotated templates around a dimension that multiple templates shared. He also assembled templates in groups to illustrate how an interlocking set of templates might fit together, stretching them out in a pattern to resemble the joints between stones in an arch (see figure 9).

Figure 9: Deconstructing and Reconstructing Forms

Bosse made sense of these operations by showing rather than telling his readers what to do (providing "rules of practice"), but he also gave his readers visual hints about how to make a "theory of rules of practice," e.g., to make sense of how the technique worked. These

hints were not explanations of why the geometry worked, but indications of how the drawing practices produced usable templates. Bosse created repetitions that revealed differences with sets of "revolving" templates that illustrated their multiple lines of connection. These images allowed readers to "experience" relationships among the forms of the templates, and showed them rule-of-thumb practices for comparing dimensions across templates to check to see if they had been drawn well. In this way, Bosse provided a visual basis for inarticulate thought about geometrical relationships, and gave his readers ways to imagine how technical drawing produced useful results. This way of picturing geometrical relationships gave masons a way to internalize geometrical logics through practices, learning to anticipate how their drawings would affect the templates for the stones.

Bosse created these associations among templates and lines by making a "looking glass" world or uncanny version of familiar reality. He treated templates like pieces of paper in a book of shapes, manipulating these forms in a very abstract way, but using precedents from his own concrete experience in the figured world of printmaking. Templates were treated like paper; they were bound together along spines or folded and unfolded, turning flat paper into 3D forms and back again. He brought a different but recognizable type of artisanal

labor to scaffold the geometrical imaginary of masons as they tried to draw templates using geometry. (Figure 10)

Figure 10: Assembling Templates into Shapes for Stones

Detached from the commonsense world, this folding and unfolding was imaginable and gathered its own logic (cf. Bowker). In these ways, Bosse showed masons how to think differently about arches, and to expand what they imagined they could build.

Having defamiliarized stone cutting by placing it in an uncanny but recognizable figured world, Bosse started to refamiliarize stone cutting by bringing the templates to stones (figure 11). Using naturalistic imagery once again, Bosse juxtaposed templates to building blocks, showing how the latter could be honed to fit the former. He placed the templates by the T-bevels, straight edges, compasses and squares of masons, presenting them as tools of the trade for cutting stone.

Figure 11: Using Templates in Stone Cutting

In this illustration, the templates became pieces of paper, nailed to a wall in a mason's workshop-- part of the everyday world of construction. The templates and stone faces were still marked with

letters to connect locations on paper to locations on the quarried stone, but the stone was depicted as a material entity to chisel, not to draw. Bosse did not detail how to finish the job because this was what masons knew how to do: make the stones smooth, and finally curve the wedges for the arch. He returned his readers to the traditional figured world and tools of masons, having taken them on a journey into a new world of imagination and drawing practice.

The "going back and forth" between geometry and traditional practices that Bosse promised at the beginning of the book (Desargues and Bosse 1643: 25-52) had taken readers along a cognitive trajectory that was not articulated, but surprisingly complex: from thinking about the three-dimensional world of stones to a two-dimensional world of geometrical calculation to a three-dimensional world of intersecting planes and finally to a set of templates and methods of measurement for reassembling stones as three-dimensional objects.

Not surprisingly, Desargues and Bosse were criticized by some stonemasons for developing methods that were cumbersome, and that did not teach masons to do something they could not do already. Desargues replied that he only wanted to perfect the process, not stop artisans from using techniques that already worked. But the mathematician also became an architect to show that his method worked in practice. Desargues had developed an inarticulate means for making custom templates, and Bosse had developed a pedagogical

practice, showing how to use it as a difference to make a difference. The technique gave masons technical drawing skills they could use to address emerging trends in architecture and enter the figured world of humanist culture and classical inheritance as skilled practitioners.

Conclusion.

Bosse adressed artisans in a period of fundamental cultural transformation-- a time of shifting habitus. The medieval world was being undermined by humanist culture in uneven patterns of change, driven by an underlying dream of reviving the classical tradition. In mid-17th-century France, the necessary elements of the new figured world of humanist modernity were not all in place to make the connections to ancient history seem seamless, natural. There was still the open question of how to develop the cultural practices to revive ancient architectural forms. There were some precedents to derive from ruins and there were intact traditions of construction from Roman times, but much knowledge of ancient construction was missing. As Ann Blair (2010) has noted, humanist scholars not only made ancient ideas accessible, but also made the knowledge gaps palpable. Desargues seemed devoted to addressing the problem of lost tacit knowledge, using ancient mathematics to create tools for new art, and Bosse found methods of virtual apprenticeship to teach Desargues' methods for dreaming up and building a heritage and destiny from the

classical world.

The search for ways to revive the culture of the ancients was guided by a shared imaginary cultivated by humanists that treated Europeans as heirs to the classical tradition. The logic behind developing new practices was to make modern life more like ancient life. This work not only required scholars who could describe the ancient world, but also artisans to conjure up a heritage of practices and artifacts. A heritage had to be a form of practice to be alive; it could not simply consist of a set of exemplary ancient works. Humanist culture had to extend to the people of the third estate who were the only ones who could make the heritage live, turning the dreams of scholars into material practices and performances of competence. So, artisans were needed to turn humanism into a habitus: a constellation of taken for granted predispositions and logics of practice directed toward dreams of classical cultural descent.

The habitus, as a figured world, is not just a tool of social reproduction. Its inarticulate practices and predispositions support improvisations around imaginaries that Bourdieu does not recognize. The creativity of this extra-discursive world gives the habitus powers to change culture outside discourse. That is why the habitus is so powerful, and why patterns of reproduction are robust but unstable.

As an advocate of education, Bourdieu saw no virtue in inarticulacy. And as an upwardly-mobile scholar trying to escape his

habitus to become a professor, he thought of the habitus as a trap. So, he had no interest in considering how his own habitus might have served his creativity, making his thought unlike that of most other scholars. But he became a great sociological trickster who would rattle the field by reading powerful cultural forces that other people did not see or recognize as important to social relations. As though he had learned from Polanyi, Bourdieu turned used his experiences to break with commonsense reasoning. But like Panofsky, he failed to see the importance of the masons and stonecutters to the gothic cathedral, or the spiritual yearning they honed against stones (cf. Scott, 2003).

To appreciate the power of inarticulacy to reshape cultural imaginaries through experiments with new forms of habitus, we need to look beyond Bourdieu to the culturally orthogonal political movements like Occupy and the Arab Spring. These movement mainly "happen," playing out narratives without clear plans (Alexander, 2011). Their actions are absurd but not random-- responses to shifting political imaginaries. Participants refuse to accept political commonsense, interrupting rather than fighting the social relations of power that oppress them. They try to live differently, building encampments and creating art-- designing habitus through material practices as a kind of political thought experiment. These movements make no sense in relation to familiar political practices and ideology, and often lead to power vacuums because they do not have articulate

goals or policies. But they hold out new political imaginaries that make the old ones hard to sustain. They experiment with the habitus of political life because they recognize that normal politics would never get them what they want. Understanding these movements as forms of inarticulacy and expressions of tacit knowledge, we can see more clearly how the habitus works not just as a tool of social reproduction through culture, but as an inarticulate alternative to commonsense. The habitus may silently reproduce relations of power most of the time, but it can also turn trickster, using tacit knowledge to pursue dreams and hone aspirations.

Bosse's book helps to amplify our understanding of cultural inarticulacy and learning. It illustrates the power of cultural imaginaries in a period of cultural change, showing how new ways of dreaming about what to do open up opportunities for building new practices and theories of practice. Dreams about arches and their plasticity allowed masons to reimagine how the world could be built differently and embody different principles of design. And this allowed them to dream about arches and elements of classical architecture as their heritage embedded in their eyes, hands, and mind.

Paying attention to cultural inarticulacy and its power allows us to approach cultural analysis in sociology differently. By treating cultural artifacts like architecture as iconic, we can begin to understand their silent power (Alexander, Bartmanski and Giesen,

2012). But by recognizing how they work outside discourse, can we more fully appreciate how their power works through cultural imaginaries. We can see this power in Fernando Dominquez-Rubio's work on art museums and the celebration of objects (2013, 2014), Claudio Benzecry's book (2011) on the opera house in Argentina and the power of the audience, and Victoria Johnson's writing (2008) on the Paris opera and why it was able to survive the Revolution. Places and things carry dreams about art and identity that animate cultural practices and politics; thinking about their inarticulacy helps explain relative impotence of words to things all these cases. Inarticulate power of culture has also been studied by Barry Schwartz (2000) in his work on collective memory and memorials. He shows how sites of collective memory invite people to experience connections to the past more than know history. Inarticulacy is also clearly a source of the power in works of art such as the paintings that Robin Wagner-Pacifici (2005) studied to analyze the art of surrender. Imagining surrender as a performance of dignity in a figured world of gentlemanly conduct makes surrender seem important to perform with grace rather than anger. Buildings and paintings, set designs and costumes all scaffold and emerge from cultural imaginaries that seep beyond discourse, giving social life inarticulate qualities that exercise a distinct form of cultural power. The point of this paper is simply to make the character of this inarticulacy visible, and show the importance of tacit knowledge

not only to the habitus, but to culture more generally.

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1 The work of Desargues was rediscovered by mathematicians and analyzed in the 19th century by M. Poudra who showed how the five planes related to proving lines. Desargues, Gérard and M. Poudra. 1864. Oeuvres, vol. 1. Paris: Leiber. 1) The *plan horizontal ou niveau* was the horizontal plane or level at the front of the door, forming the foundation; 2) *l'alignment nivelée ou plan de face* was the vertical plane of the wall in which the doorway was to be placed; 3) *le plan du chemin* was the rise or descent of the ground within the arch; 4) *le plan de route* or *route nivelée* was a vertical plane running through the arch parallel to the interior sides of the pillars; 5) *le droit aux face et niveau* were auxiliary planes whose intersections with the three other planes provided a way to measure the angles made by these planes where they met.