

Mangling Expertise Using Post-Coding Analysis to Complexify Teacher Learning

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A recent movement in teacher education research encompasses working with and through theory (Jackson & Mazzei, 2012; 2013). In response to the call from Jackson and Mazzei (2013) to use theory to think with data and use data to think with theory (p. 261), I hope to portray the complexities of teacher learning by avoiding models of teacher learning and development that tend to reinforce positivist, linear conceptualizations of expertise (Strom, 2015). In this article, I put to work multiple concepts to produce a more complex reading of the transformation of teacher expertise. In particular, I use post-coding analysis (St. Pierre & Jackson, 2014), and provide a diffractive reading (Barad, 2007) of the entanglements within a mangle of practice (Pickering, 1995). My purpose for this article is threefold. Primarily, I revisit previously analyzed data from a veteran Reading Recovery (RR) teacher, Grace, in an attempt to understand the intra-action, or intertwined entanglements that materialize in relationship with/in each other. I focused on smaller, meaningful, compelling situations that arose from my previous coding.

In my study of RR teacher expertise, I found that methodologies commonly used in qualitative research did not provide me with a way to consider the complexity related to the process of teacher learning. I conducted a qualitative case study aimed at understanding the exper-

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tise of RR teachers. In my first analysis of the data, I implemented the Model of Domain Learning (MDL) (Alexander, 1995) as a descriptive and analytic framework. The MDL offered me a multi-stage, multi-dimensional lens with which to view cognitive and affective aspects of the development of expertise in teaching reading. However, I found the MDL limited my ability to understand the intertwined elements related to development of teacher expertise. Thus, I engaged in a diffractive reading of the data (Barad, 2007) and put other theories to work. Barad describes diffractive reading as the act of (re)turning to the data and attempting to understand it from different perspectives. To read my data diffractively, I turned to complex, non-linear thinking (e.g., Byrne, 1998; Cilliers, 1998; Davis & Sumara, 1997, 2006; Mason, 2008). Kohn (1996) suggests that everything, from the furniture, to the teachers' voice, to the climate within a classroom or school, influences learning experiences. To account for all these elements, human and non-human, that may influence teacher learning, I engaged with the work of new materialists (e.g., Barad, 2007; Pickering, 1995). New materialisms provided me a different way to understand the complex, entangled, intra-acting elements related to Grace's expertise.

Thinking with and through a new materialist frame, I employ the notion of the *mangle* (Pickering, 1995)—that is, the intertwined, entangled continuous relationship among a heterogeneous mixture of material and discursive elements, human and non-human, in the process of their ongoing production. I diffractively read data related to the production of Grace's knowledge and practice, as well as the phenomenon of emerging expertise, as a mangle, one that is continuously constituting and constituted by the intra-action of elements, without privileging one (element or intra-action) over the other. Additionally, I interrogate my initial method of using the MDL for meaning making and explore possibilities opened up by engaging in post-coding analysis of the same data by employing a non-linear framework. Further, in hopes of problematizing teacher learning, I perform a diffractive reading that, by re-engaging with the data from a different perspective (Mazzei, 2014), allows for a different frame of reference with which to consider the complexity of the education/development of teachers.

(Re)reading Diffractively

My recent work and thinking regarding non-linear frameworks and complexity enabled me to re-enter the data and engage with what Barad (2003, 2007) and Mazzei (2014) characterized as diffractive reading. According to Barad (2003, 2007), a diffractive reading of the data denotes

(re)turning to the data using myriad perspectives and approaches, with each reading producing different insights. To (re)engage with my data, I chose to conduct a diffractive reading through the frame of new materialisms (DeLanda, 1997; Braidotti, 2006; Hekman, 2010). New materialisms conceived as a plural indicates myriad iterations of the materialist turn (e.g. material feminisms, new materialism, incorporeal materialism), each related, but also unique and distinct from each other (Coole & Frost, 2010). Diffractively reading the data with new materialist perspectives allowed me to interrogate my first analysis using the MDL and to complicate my accounting of RR teacher expertise.

This current conceptualization of the data is drawn from my larger qualitative case study project investigating the developing expertise of RR teachers.¹ In my first analysis of the data, I implemented the aforementioned a priori framework, the MDL (e.g., Alexander, Jetton, & Kulikowich, 1995), to guide the coding and categorizing process of the data into themes. The MDL posits that expertise develops across stages and as a result of interactions among knowledge, interest, and strategic processing. Analyzing the data through the lens of the MDL proved somewhat fruitful in that it appeared to model the transformation of teacher expertise in more complex ways than previous stage models (e.g., Berliner, 1994). My analysis revealed an under-conceptualization of the complexity related to the continuous evolution of expertise with/in elements/environments with such blurred boundaries. Acting as specific limiters were my presupposed boundaries and properties of each entity prior to my analysis of the data. The subsequent qualitative coding process I undertook reified knowledge, interest, and strategic processing as separate, pre-existing, interacting entities. Thus, I cemented the entities into static categories. Because of this limitation, I was not able to capture complex, dynamic, and the always-emerging phenomenon of becoming expert RR teachers. The MDL framing teased at the edges of the complexity, but in the end, the limitations of the framework and the constraints of the coding process obfuscated my ability to portray expertise as a continuous act of becoming.

My recent thinking about complexity, however, evoked by my employment of the MDL, led me to re-engage with my data, and to think through and with a different, but related, non-linear theory. In my first engagement using the MDL to analyze the data, I employed qualitative apparatuses (e.g. questionnaires, interviews, transcripts, and coding) rather than the quantitative apparatuses most often used in studies using the MDL (e.g., surveys, tests, statistical analysis, quantitative software). While my qualitative approach did elucidate aspects of the MDL that may need further or deeper conceptualization, specifically,

the notion of interest as a motivating force for teachers, I experienced an uneasy feeling, a physical response, to something that seemed missing. I felt something had eluded my capture, escaping the collection and measurement apparatuses themselves. In other words, subsequent to my first data collection and analysis, I remained haunted by in(visible) data (Taylor, 2013).

Thinking through and with New Materialisms

New materialisms comprise non-linear frameworks that shift the dual structures of humanist traditions to a posthuman frame, rejecting dichotomized thinking regarding subject and object and/or material and discursive in the generation of knowledge. That is, new materialisms seek to show how the mind is rendered material, as an idea of the body, as well as how the mind has the body as its object—and thus, acknowledging matter as necessarily something of the mind (Barad, 2007). New materialists theorize that there exists a continuous emergence of knowledge and practice with/in the entanglement of heterogeneous material and discursive elements, human and non-human. These entanglements are considered intra active. That is, they possess the agency to enact their own boundaries, and don't necessarily relate to or respond to boundaries proposed by a subject (human) (Barad, 2003, 2007).

New materialisms share some commonalities with the MDL. For example, both theories posit that transformation exists at the point of interaction of knowledge, interest, and strategic processing (MDL) or with/in the intra-action with/in multiple elements (new materialisms). As conceptualized by the MDL, interaction refers to the interplay among presupposed, bounded entities. The new materialist notion of intra-action, however, suggests that unbounded individual elements “do not preexist as such but rather materialize in intra-action” (Barad, 2012, p. 74). Put another way, rather than assuming the independent or prior existence of bounded, individual entities, such as knowledge or interest, the concept of intra-action supposes that elements exist with/in phenomena of particular materialized/materializing relations in an “ongoing iteratively intra-active reconfiguring” (Barad, 2012, p. 74). In this sense, knowledge, interest, strategic processing, and expertise are iteratively emerging, intertwined, entangled relationships that continuously (co)constitute each other, and/or are always in (co)constitution with each other, as well as with/in material and discursive elements—a mangle.

Additionally, new materialists posit mangles include agentic acts and accompanying asymmetric power relations among material and discursive elements (Barad, 2013; Pickering, 1995). Domain specific phenomena that arise from a mangle requires an interchange of agency among human

and material elements referred to as the “agency of discipline” (Pickering, 1995, p. 116). That is, at certain points in the learning process, humans initially and intentionally invoke their agency on material and/or discursive elements to create thoughts or ideas. At other points, agency is invoked by material and/or discursive elements. At these points, the agentic act of material and/or discursive elements creates conditions in which humans follow standard procedures dictated by the particular domain or discipline. Thus, there exists a “dance of agency” (Pickering, 1995, p.116) between human, material and/or discursive elements.

Pickering (1995) goes on to posit that with/in this dance of agency, barriers to learning, or resistances, exist. For example, within the domain of Reading Recovery, a RR teacher is trained to use a data collecting and analysis tool of students’ reading behaviors, a running record.² In her analysis, she surrenders to nonhuman (material and discursive) agency—that of the running record—which demands the enactment of a standardized procedure. Subsequent to surrendering, she may once again enact agency over the material and discursive elements of the running record, reconceptualizing the information to help her better understand the reading strategies enacted by her student. The continuous interchange between each of these agentic acts (re)produces particular knowledge and practice. In the ongoing interchange, the RR teacher poses new, different, or extended thoughts or ideas. She abdicates her agency to that of the nonhuman (running record) for a response, as she responds in kind. If the RR teacher is confused or surprised by the knowledge produced by the agentic action of the running record, however, a barrier is created. She must change or “tune” her agentic action and make an accommodation in her response to that resistance. This tuning or accommodation might include making revisions to her goals and intentions for her student, as well as to the material document of the running record. She may, for example, reconsider and recode the reading behavior previously added to the running record or she may review and change a short-term goal for her student. In this way, there exists a continuous relationship between resistance and accommodation in the (co)constitution of knowledge and practice.

In the section that follows, I use the notion of mangle in my attempt to account for the complex intra-actions in the learning experience of RR teachers through which the particular knowledge and practices emerge, persist, and transform with/in physical, social, and political domains.

Mangle(ing) of Practice

The *mangling of practice* (Pickering, 1995) refers to the entanglement of and ongoing intra-actions among the temporal meanings, boundaries, and properties of material, discursive, and human elements. For the purpose of my post-coding analysis, I viewed *mangling* as the entangled process that results in the continuous production of knowledge and practice with/in a situated context. I viewed the *mangle* as the intertwined material and discursive elements involved in the production of particular knowledge and practice—For Grace, this meant the mangle of her materials from a past classroom life, our discourse related to those materials, her emotional reaction expressed physically, and the ways in which I recorded and interpreted her responses. Thus, the act of mangling practice invited me to question and rethink my assumed ontological separation among the human and nonhuman, the subject and the object. It challenged commonsense (Deleuze, 1990) notions of received knowledge and conventional modernist binaries between humanism and materialism and subjectivism and objectivism (realism), while helping me conceptualize new connections among them (Mulcahy, 2013).

As Hekman (2010), theorized, discursive elements, such as texts and dialogue, “do not just describe, they produce” (p. 76) phenomena, through entanglements with material elements, human and non-human. That is phenomena, such as expertise, are created through the *intra-action* of observer (in this case, the participant and myself), the apparatus of observation (my tablet and computer, the transcribed interview, the computer, my applied codes), and the object (materials, language, and embodied responses shared between us). Further, the mangling of practice implies that matter (e.g. things, technologies), discursive elements (e.g., texts, dialogue) and human elements (e.g., people) do not have *inherently* determinant meanings, boundaries, privilege, or properties (Barad, 2003). Additionally, elements enact agential cuts in their continuously co-creation of each other (Barad, 2007). That is, elements/entities materialize with/in ongoing agentic relationships, the nature of which determines the always-becoming contours, context, and content of the elements of the mangle. Thus, element/entities of knowledge, interest, and strategic processing are continuously (re)constituted with/in agential relationships.

As noted, in my first analysis, I presupposed the meaning, boundaries, and properties of knowledge, interest, and strategic processing. Because I presupposed their existence, I made particular decisions made about my measurement apparatuses and myself as researcher. Those decisions became consequential in how my agential cuts (Barad, 2007) materialized particular boundaries and properties of each element/entity. For

example, in my first analysis, I (human element) created questions for the questionnaire and interview (measurement apparatuses; discursive elements) that highlighted my conception of the bounded qualities and emphasized the interaction of the element/entities. In our conversations, these apparatuses and discursive elements led the participants of my study and me to discursively create specific boundaries and properties of knowledge, interest, and strategic processing. Further, in my analysis of these conversations, I engaged the process coding (measurement apparatus; discursive; material) to further refine boundaries and properties of the element/entities. Interestingly, when I encountered a barrier to my understanding of the data, a resistance, I typically allowed my presupposed cuts of the elements' boundaries and properties to take precedence over the iteratively emerging elements that continuously emerged with/in the relationship among all elements. In other words, I did not closely attend to the dynamic phenomenon of the intra-action. As such, I was not mangling practice and examining elements such as knowledge or teacher expertise as dynamic phenomena to which properties and dimensions are neither given nor discursively constructed. To more fully understand teacher expertise as an always emerging dynamic phenomenon, then, is to consider the intra-action among all of the elements/entities of the mangle in which they are continuously produced.

In sum, mangling practice shifted my perspective of interest, knowledge, and strategic processing. Rather than considering these dimensions as separate entities that interact across and through boundaries, I described them as intertwined, entangled elements that materialize in (co)constitution with/in a larger mangle within a particular event discussed later in this paper. I engaged with post-coding analysis to (re)consider and (re)conceptualize the phenomenon of the continuous emergence of Grace's expertise in teaching RR, as well as the ongoing entangled production of element/entities, knowledge, interest, and strategic processing with/in a mangle.

Delving into Post-Coding Analysis

As stated earlier, my first analysis of the data using the MDL was based on qualitative coding grounded in positivism. My taken-for-granted understanding of coding aligned with the critique of such presented by St. Pierre and Jackson (2014) who suggested assumptions that underlie this data analysis process: (1) presence is a criterion for quality; and, (2) collected words exist without interpretation by the researcher. As I measured the data as discrete, codable units, I made a conscious decision to ignore the fact that the language was both contaminated by meaning and rife with meaning deferred. As referred to earlier, my decision to

consider the data as an object to be coded and wrangled into a linear form created a great sense of internal unease embodied by my physical reactions. I sighed...I whined...I walked away from the computer...I pulled my fingers through my hair...I opened and shut my laptop cover...I announced, "I am just making this up!" to an empty room. Innately, I understood that I was dealing with complex, contextually reliant, emerging elements. However, my measurement apparatus and the use of a priori concepts in trying to "find" meaning in my data, equipped me to construct knowledge, interest, and strategic processing as interacting, separate, bounded entities. I was frustrated by my inability to acknowledge the complexity of intra-action. Instead, I felt I was engaged in the process of elaborately coding and presenting the data, without a clear purpose, lacking in conceptual foundation (Young, 1969).

To settle my unease with the coding process, in my second analytic engagement, I attempted a diffractive reading of the data, a "post-coding analysis" (St Pierre & Jackson, 2014, p. 717), to (re)consider the data by thinking with and through theory. By "approaching the data with theory first, and what counts as data second" (St. Pierre & Jackson, 2014, p. 715), I viewed the data using a non-linear frame and focused on a deeper and different analysis of smaller, meaningful sections. The event that follows this section was deemed meaningful by myself as researcher because it provided me ample opportunity to read diffractively, revisiting my data multiple times, with a new materialist frame, "seeking different patterns that make a difference" (Barad in Dolphijn & Van der Tuin, 2009, p. 1). The notion of diffraction differs from the concept of reflection or reflexive thinking. Instead of positioning subject and object as mirror images in which one examines the other, diffraction supposes the entanglement of subject and object in the emergence of phenomena (Barad, 2014). Thus, diffraction allowed me to examine the intertwining of matter and meaning and acknowledge the theorized, yet unintentional, agency of matter. (Barad, 2007). That is, diffractive reading led me to view the data itself as entanglements of material and discursive elements, and as such, (re)constituted my own particular knowledge and practice. Additionally, I continued to intra-act with MDL. By attempting to think through the framework with a new materialist frame, I engaged in the process of interrogating the theory, gaining insight, and producing new patterns of thinking about the emergence, intra-action, and agency of elements, knowledge, interest, and strategic processing. In other words, rather than viewing each as a separate bound entity, I was able to examine the phenomena as dynamic intra-action and agential cuts in their continuous production and entanglement.

My post-coding analysis consisted of a process of (re)reading the

data and setting aside my presupposed notions of knowledge, interest, and strategic processing. Rather, I attempted to identify the processes related to the intra-active relationships among the intertwined, entangled elements/entities with/in a particular situation. I first identified the elements of the mangle, followed by an analysis of their dynamic, iterative relationships. Consequently, I rendered particular knowledge, practices, and understanding of the emergence of expertise with this re/reading of the data. I present this re/reading regarding the development of RR expertise of Grace, a participant in my study, next.

Grace and the Continuous Emergence of Expertise

Grace was a classroom teacher with 20 years of experience prior to becoming a RR teacher. She had become a RR teacher eight years prior to our meeting, in the same building in which she worked as a classroom teacher. During her years as a classroom teacher, Grace was involved in the transformation of how the teaching of literacy was perceived and carried out in her school. In conjunction with her building's RR teacher, with whom she collaborated at the time, Grace created her own literacy curriculum. In our conversations together, she reflected upon her perceived expertise in teaching literacy to young children and her role as a sought after literacy instructor. She collaborated with other teachers, offering advice and knowledge regarding teaching literacy in primary grades. Ultimately, Grace desired to become a RR teacher. Subsequent to the departure of the building's RR teacher with whom she worked, Grace applied for and was selected for training. She related that she was thrilled when called upon to fill the space left by the departing RR teacher—a position for which she had waited seven years to open.

In my first round of data analysis using the MDL, I noted that Grace evidenced intense levels of interest in RR. She had attempted to engage in the learning activities and opportunities offered throughout the ongoing professional development. She indicated that there were aspects of the training and professional development with which she did not wish to engage and/or lacked the ability to engage. According to the MDL, Grace was in the beginning stages of expertise development. I was puzzled. When viewed through the lens of the MDL, I could expect that, after such a lengthy time participating in related learning activities (8 years), Grace's knowledge of and practice in RR would be similar to those exhibited by her peers. This puzzlement served as an analytic barrier for me—that is, I encountered resistance to my initial ideas and thoughts. To accommodate that resistance, I engaged in shifting my frame to that of the mangle. To do so, it was necessary to revise the

material element of my measuring apparatus (coding) and diffractively (re)read my data.

Intra-action Among the Elements/Entities of the Mangle

My post-coding analysis focused on a compelling event that existed in Grace's data, one that haunted my thinking (Taylor, 2013). In mangling the three elements of knowledge, interest, and strategic processing, I viewed them as intertwined dynamic intra-actions entangled with/in temporal and bounded spaces. In the event with Grace described below, I identified these elements mangled with:

- Grace's reflections upon and her memories of her training year
- magnetic letters typically used in RR to scaffold students' processing of letter/sound relationships
- RR texts (Clay, 2005) (e.g., the guidebooks designed to support the development of personal theory about teaching and learning literacy)
- Grace's meaning associated with the text as (co)constituted in dialogue with her teacher trainer and colleagues
- our dialogue (Grace and myself) about her training year
- my socio/historical/cultural experiences with becoming a RR teacher
- my measurement apparatus (the interview questions)

In the diffractive reading of the data and post-coding analysis that follows, I attempt to shift my view of expertise as a pre-defined entity with inherent hallmarks and properties, and instead, think of it as dynamic, a continuously produced with/in and (re)producing phenomenon. Expertise, as I discuss below, is (re)constituted with/in historically and culturally situated intra-actions of material-discursive-human elements.

Mangling Grace's Reflections on Her Training Year

In my original (re)reading of the data with the MDL, I interviewed teachers about their early experiences with becoming a RR teacher (including their training year). My interest in their early experiences was due to my position as a former RR teacher. I was familiar with the intensity and difficulty of the training year and understood it as different from typical professional development and/or coursework experienced by most classroom teachers. I considered the level of work and accountability to be atypical from most other professional development or even

graduate coursework. I wondered about the influence of this training year on the motivation (interest) of the participants. Thus, my measurement apparatus (my interview questions) positioned “interest” as an entity with inherent characteristics and separate from other intra-acting elements. In my analysis using the MDL as a coding framework (the measurement apparatus), I suggested that some of Grace’s differences in the development of her expertise might have hearkened back to her training year. In coding Grace’s responses, I noted that when referring to her training year experiences, she demonstrated powerful embodied emotions. For example, when I asked her about her earliest experiences with becoming a RR teacher, Grace whispered, struggled to hold back tears (eyes filled with tears, lips trembled, gazed up at the ceiling), and appeared frustrated (exasperated voice, body leaned forward, poked table with finger to emphasize points). Embodying her feelings, she shared:

Let me tell you something that I had to get over [pause] I had to get over it. I spent 20 years in the classroom. I was a primary teacher. I built my own spelling program. I was doing a lot of word work. And in my training year, there were seasoned teachers and the teacher leader that we had who was not TL [current teacher leader] [pause] the teacher trainer that we had was very critical of the experience that we brought to the table. If I felt I had an experience I wanted to share or a connection [I didn’t share] because this teacher trainer did not want to hear it. She did not want me to bring any experience from my past. That was my [emphasis added] interpretation. Not only by what she said to me, but also to other people, so it wasn’t just me. I felt like I really couldn’t verbalize. Having said all that, that’s the part I had to get over. (Grace, Interview 1)

Additionally, I observed in my data analysis that the other participants had not demonstrated similar reactions when asked about their training year. Further, as I coded this event, I registered my own embodied emotions. The process felt incomplete. I felt haunted by something that was missed and was missing. My intra-action with/in this mangle related to Grace’s training year led me to (re)consider that in this situation, the MDL might not illuminate the complex, meaningful intra-action among Grace’s embodied emotions, discursive responses, and material elements.

Mangling the Mangle

Adding to my understanding of that event, I noted that in my analysis of my second conversation with Grace, she spoke endearingly of her classroom experiences and surrounded herself with material elements of her former life as a classroom teacher. Her current RR room was a bright, cheery space full of items with which to teach literacy; a small

table and two tiny chairs, various iterations of letters and flashcards, leveled texts organized in boxes, myriad markers, stickers, paper, white boards, and so on. Each marker, clip, text, and slate appeared to have a specific place. Lining the shelves near the ceiling along the walls, out of the students' reach, were cardboard boxes of various sizes and shapes. For the second interview, we sat beside each other at the small, low table designed for much smaller bodies. When I questioned her about her teaching practice, Grace would arise and trip lightly around her room to gather materials to share as she talked. Most items were kept at a low level, accessible to young students. Grace was cheerful and happy as she physically shared the multitude of the items she had developed to teach RR students; a slinky with which to help students stretch out words, flashcards with fluency phrases, and multicolored chips for students to use for distinguishing sounds. The material elements in this mangle seemed to evoke pride in Grace. The relationship between Grace and her material elements intra-acted in ways that continuously produced particular knowledge and practices related to each. For example, Grace imbued the slinky with RR aspects, and because she was complicit in the dance of agency. Grace used the stretchy slinky with students to engage with standard RR procedures (e.g., stretching out sounds in words).

In our conversation, I alluded to her past experiences as a classroom teacher. The look in her eyes changed and she seemed resigned (sighed, looked up at boxes). She pulled out a chair so she could reach the boxes on the upper shelves. Grace saved the materials she had developed 8 years prior, surrounding herself with them. She opened each box containing centers, activities, and booklets. She used her hands to rub the tops of each item with an almost loving touch. She was clearly in a relationship with these materials. Her voice shifted to a whisper. The entrance of these material elements into our conversation changed the tenor of our talk. I thought about what it meant for Grace to have a RR teacher trainer, someone for whom she most likely harbored tremendous respect, seemingly dismiss her experiences and her knowledge, representative of the discursive and material elements of her mangle. In our first conversation, when I asked further about her training year experience, she stated:

That's where a lot of my unassuredness comes from, because the connections that we were making were not validated and I couldn't verbalize them because I didn't want to be embarrassed and I didn't like being reprimanded. (Grace, Interview 1)

She went on to explain:

So, I still [hesitates] I still was feeling [hesitates, hangs head] still hurt and I'm still dealing with them [hurt feelings] but I'm a big girl. I re-

ally felt [swallows, hesitates, looks down] I just felt like I couldn't get as much out of it. I couldn't share as much as I wanted to share and I'm not a bossy person. I wasn't trying to dominate the conversation. I wanted to know, "Is that what you're talking about?" "Is that the kind of word work you're talking about?" "Is that what we should be doing?" But I didn't. (Grace, Interview 1)

Grace further discussed her reaction to the behavior of her teacher trainer, explaining how she attempted to accommodate a barrier to her learning through resistance. For example, she refused to engage with the RR practice related to how to teach word work. Additionally, she described how she went through the motions, but did not attempt to fully engage with the ongoing reading of the guidebook and participate in the reflective dialogue that is considered vital to the process of RR teachers learning to theorize their practice. Grace's knowledge and practice materialized with/in this interplay—in this case, how she accommodated barriers with resistances related to word work, the magnetic letters, the teacher trainer, and her prior knowledge of phonics produced with/in the context of a classroom. In fact, eight years following her training year, Grace still struggles somewhat with word work and the use of magnetic letters. She finds the letters themselves as well as the processes of using them to be anxiety producing.

Through a (re)reading of the data, the mangle elucidated the influence of material elements (e.g., teacher trainers' words and actions, magnetic letters, guidebook) in the production of Grace's knowledge and practice. In addition to RR items, many of the material elements with which she surrounded herself, such as the boxes on the upper shelves, related to her previous life as a classroom teacher, the socio-historical-cultural-political realm in which she perceived herself and was perceived by others as exemplary. These nonhuman, material elements may have offered continued comfort to Grace after her encounters with her teacher trainer and subsequent struggles to develop expertise in teaching RR.

Material elements can also be viewed as intra-acting with/in the current political context related to high accountability for teachers. Increasingly, teachers are required to report statistical data related to students' assessment scores and are often perceived singularly accountable for the progress of their students. RR teachers are required to report their student achievement scores to a national database. The participants in this study, including Grace, receive a report of the progress of their students as compared with RR student progress taught in demographically similar national, state, and local contexts. Many states and districts base future funding of RR positions on the success of the teachers as presented in these reports. By keeping her past suc-

cesses materially present, Grace seemed to engage in accommodating a barrier enacted by her teacher trainer regarding her prior knowledge and past career and by reports that she perceived as possibly painting a less than exemplary portrait of her practice. The materials may have allowed Grace to continue acknowledging her perceived strong ability to teach literacy. Those same material elements intra-acting with acts of resistance, however, may have also constrained her continued learning as a RR teacher:

I don't know if it's appropriate [pause] no, let me go back [pause] sometimes I don't share things at the meeting because I don't want someone to tell me that's not what we do at RR [pause] [knowledge and practices from her classroom life] going back to the time that I got reprimanded [cleared throat, pause] I hadn't thought of that until now. (Grace, Interview 2)

In this statement, Grace appeared to acknowledge the intra-action among the human and non-human elements, as well as the intra-action among temporal and political domains. Her perception of past reprimands prevented her from fully engaging in practices designed to promote and develop expertise in RR. She specifically referred to a few materials she used in her own practice that she considered unsanctioned by RR (which is somewhat notorious in exerting control over the selection and (non)use of particular items). For instance, Grace used commercially produced phrase fluency flash cards not sanctioned by RR. In this dance of agency, then, Grace encountered a barrier (a reprimand) and accommodated that barrier by tuning her practice, revising material elements, and resisting standard procedures of RR. This agentic interchange among myriad elements of this mangle was instrumental in Grace's continuous development of particular knowledge and practice, in realizing her personal conception of how students develop fluency and in her practice of using of commercially created fluency flashcards.

Discussion and Conclusion

In a sense, by engaging in post-coding analysis and enacting a diffractive reading of the data, I inherently changed the measurement apparatus from coding presupposed entities of knowledge, interest, and strategic processing to identifying the elements of a particular mangle and examining the intra-actions among those elements. That is, rather than coding knowledge, interest, strategic process, and expertise as determinant, bounded entities, I was able to analyze compelling and meaningful points of intra-action among all elements, material, discursive, human and non-human, in the described event. Thinking through and

with non-linear, complex theory acknowledges that teaching is a complex practice and challenges currently held dichotomous, binary notions. By disrupting the normalized, reductionist view of teacher development, our field may begin to appreciate the nuances of how teachers learn and develop expertise in particular domains, as well as better understand our role as researchers in facilitating that understanding.

The boundaries and properties of elements that comprise the complex processes of teaching and learning are determined with/in dynamic relationships among each other as well as with/in relationships researchers have with their chosen measurement apparatuses (Barad, 2003, 2007). Hence, by engaging in positivist, reductionist analysis, we create separate, determinant, bounded entities rather than acknowledging their continuous production and emergence as dynamic phenomena. Alternatively, by engaging with diffractive reading and conducting a post-coding analysis of my data (St. Pierre & Jackson, 2015), I suggested that both the MDL and the mangle view knowledge and practice as in continuous processes of transformation as teachers develop expertise. However, the non-linear architecture and the intra-active nature of the mangle complexifies the production of knowledge, practice, and development of expertise with/in temporal, political, and social realms. The mangle, as a conceptual tool acknowledges the asymmetrical power relations with/in that undergird the agentic action of all elements in the production of particular knowledge and practice. Thus, the mangle allowed me to reconceptualize the “dualisms of nature and culture, human and non-human, discursive and material” (Hekman, p. 71). In sum, using the mangle to conduct a post coding analysis helped me integrate the disparate elements that constitute our understanding of knowledge, practice, and expertise. This type of non-linear, complex theorizing may have the capacity to facilitate the capture and complex production of knowledge and practice, and better understand the development of expertise for teachers across their careers.

Notes

¹ RR is a highly effective, one-to-one literacy intervention for struggling first-grade students. The RR professional development model is atypical. Teachers are required to complete a training year and attend a monthly 3-hour professional development session (“Continuing Contact”) for the length of their RR careers. In my initial study, I elicited data from 8 participants with varied years of experience as classroom teachers (0 years to 20 years), and as a RR teacher (from 5 years in RR to 21 years in RR).

² A running record is a document on which a RR teacher records and analyzes in specific ways a students’ miscues. The use of running records to track

and analyze the reading behaviors of a student may help a RR teacher generate initial ideas or thoughts about those reading behaviors.

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