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A multifocal lens on qualitative data analysis: an affordance of networking theoretical approaches

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We address the problem of interplay between methods of qualitative data analysis and the networking of theories. When we call a multifocal lens on data analysis an “affordance,” we mean a benefit or resource that people may perceive possible when networking theoretical approaches. To situate our argument, we draw parallels between challenges in the fields of mixed methods and mathematics education. Examining the analysis methods in an empirical study of students’ conceptions of what graphs represent, we argue that a multifocal lens can help to explain complexities when investigating students’ reasoning. Our work contributes to efforts to advance the scope and depth of data analysis techniques employed when researchers network theories.

Keywords: Theories, data analysis, qualitative research, graphs.

Mathematics education researchers have appealed to a plethora of theoretical approaches, and this diversity brings richness to the field (Bikner-Ahsbabs, 2009). By networking, or connecting, different theories, researchers can embrace this diversity (Bikner et al., 2019; Prediger et al., 2008). The networking of theories is more than an intellectual endeavor; it has pragmatic roots, to contend with problems (Bikner et al., 2019). Those problems can encompass the enactment of research in mathematics education. The problem we address is methodological: the interplay between methods of qualitative data analysis and the networking of theories. Our aim is to contribute to efforts to advance the scope and depth of data analysis techniques employed in the field.

We argue that a multifocal lens on qualitative data analysis is an affordance of the networking of theories. By affordance, we mean a benefit or resource that people may perceive to be possible with a particular approach. One reason we use the term “affordance” is because of the reflexivity it implies. Our use is consistent with that of Chan and Clarke (2019), who offered the term “mutual affordance” to describe a back-and-forth relationship between theory and method, one that it is flexible and responsive rather than prescriptive. While Clarke and Chan (2019) address a broader scope of methods, we focus on data analysis. We do this in part because of the crucial role that competent analysis plays in qualitative research (Miles & Huberman, 1994).

The work of theorizing can bring forth many images for researchers. Simon (2009) put forward two images, tools and lenses, as metaphors for ways in which researchers can employ theories. A tool can function for a particular purpose; some tools serve multiple purposes, while others are more specialized. A lens can influence how people perceive a situation; different lenses can result in different explanations of a situation.

We have chosen the term “multifocal lens” to communicate how an analytic lens can make room for multiple perspectives of a single situation. One way to think of each perspective is in regard to a “focal construct” (Chan & Clarke, 2021), on which researchers may focus when analyzing a source

of data. For example, researchers may focus on students' thinking and their affect. With a multifocal lens on data analysis, researchers can investigate and coordinate different focal constructs. Multifocal approaches can strengthen qualitative data analysis, by allowing researchers to triangulate within and across different analysis methods (Leech & Onwuegbuzie, 2007).

We contend that researchers' responses to challenges facing the field of mixed methods (Onwuegbuzie & Leech, 2005) can offer insights into the interplay between the networking of theories and methods of qualitative data analysis. We highlight two such challenges, and make connections to the field of mathematics education. The first addresses a relationship between the research methodology (quantitative, qualitative, or mixed) and data analysis methods. This challenge is analogous to Chan and Clarke's (2019) argument that a relationship between theory and method be one of affordance, rather than prescription. The second addresses whether and how researchers may mix quantitative and qualitative methodologies. This challenge is analogous to the networking of theories, as researchers grapple with whether and how theories may be connected (e.g., Bikner-Ahsbahr, 2009; Prediger et al., 2008).

To organize this paper, first we draw parallels between obstacles to mixed methods research and the networking of theories. Second, we explain why we examine interplay between the networking of theories and methods of data analysis. Third, we look at analysis methods reported on Johnson et al. (2020), in which the researchers networked different theories. Our purpose is to show how a multifocal lens on qualitative data analysis can explain complexities in students' reasoning.

Parallels between networking theories and mixed methods

One aim for researchers who network, or connect, theories is to solve problems that demand multiple lenses (Bikner-Ahsbahr et al., 2019). There is a continuum of ways in which researchers may network theories (Bikner-Ahsbahr & Prediger, 2010). On one end of the continuum, researchers can develop understanding of the assumptions underlying different theories. Moving along the continuum, researchers may compare or contrast, combine, synthesize, or locally integrate different theories.

An obstacle to the networking of theories is theoretical competition in response to a quest for coherence in mathematics education. If researchers view different theoretical perspectives to be in competition with each other, the field may appear disjointed (e.g., Prediger et al., 2008). Rather than theoretical competition, researchers who advocate for the networking of theories take a pluralistic approach (Bikner-Ahsbahr, 2009; Bikner-Ahsbahr et al., 2019; Prediger et al., 2008). Meaning, a goal is to interconnect theories, rather than to advocate for the adoption of singular, unifying theories (Bikner-Ahsbahr et al., 2019). This approach can benefit empirical research, by allowing researchers "to gain an increasing explanatory, descriptive, or prescriptive power" (Prediger et al., 2008, p. 169).

An aim for researchers in the field of mixed methods is to solve problems via qualitative and quantitative methods (Onwuegbuzie & Leech, 2005). As with networking theories, there is a continuum of ways in which researchers may mix methods (Leech & Onwuegbuzie, 2009). After employing both qualitative and quantitative methods, researchers may mix these methods within and/or across different phases of the research.

An obstacle to mixed methods research is a perception of dichotomies between qualitative and quantitative methodologies (Onwuegbuzie & Leech, 2005). When researchers identify with only a qualitative or quantitative paradigm, it can create polarization. Onwuegbuzie and Leech (2005) argue for methodological pluralism. Rather than binding methods to a qualitative or quantitative paradigm, they offer a reconceptualization, such that the same type of method may cut across paradigms. For example, researchers may employ exploratory methods from qualitative and quantitative paradigms. Such an approach can serve to dismantle boundaries between qualitative and quantitative research traditions (Onwuegbuzie & Leech, 2005).

The term “pragmatic researcher” describes researchers who embrace methodological pluralism:

Becoming a pragmatic researcher offers a myriad of advantages for individuals. First and foremost, it enables researchers to be flexible in their investigative techniques, as they attempt to address a range of research questions that arise. (Onwuegbuzie & Leech, 2005, p. 383)

The field of mixed methods is a pragmatic response to the obstacle of a perceived dichotomy between qualitative and quantitative methods. In a similar way, the networking of theories is pragmatic response to the obstacle of theoretical competition in a quest for coherence in mathematics education. One way to conceive of the networking of theories is as “pragmatic theorizing.” A pragmatic approach to theorizing can allow researchers to leverage different theoretical perspectives to contend with researchable problems. Such an approach demands attention to methods, which we discuss next.

Interplay between the networking of theories and methods of data analysis

The networking of theories happens in conjunction with other aspects of research; it is entangled with researchers’ methodological decisions (Bikner-Ahsbahr et al., 2019). Radford (2008) has posited a conceptualization of theories as triplets that include systems of guiding principles (P), collections of methods and methodologies (M), and sets of overarching research questions (Q). From this perspective, theorizing extends beyond assumptions and principles to practical aspects of research (methods and questions). We view the elements of Radford’s triplets, to afford, rather than prescribe each other. While certain methodologies and research questions may be more typical for researchers operating with a certain system of guiding principles, those connections are not lock step. In our view, Radford’s triplet can extend beyond individual theories. In the networking of theories, researchers weigh principles central to different theories (P), examine how methods and methodologies may intertwine with different assumptions (M), and reflect on how theoretical assumptions can impact responses to research questions (Q).

The networking of theories is something more than triangulation via different data analysis methods (Bikner-Ahsbahr & Prediger, 2014). It is a way of employing a multifocal lens on a research setting. Researchers who network theories can employ different theoretical lenses on a single source of data. In turn, different theoretical lenses transform what gets counted as data. Hence, there is an interplay between theory and method. Drijvers et al. (2013) illuminate this interplay in their comparison of methods between two different theoretical lenses that they employed to investigate a student’s work on a computer algebra task.

In qualitative studies, the use of more than one analytic tool strengthens data analysis, because researchers examine a source of data from different viewpoints (Leech & Onwuegbuzie, 2007). We contend that a multifocal lens on qualitative data analysis is one affordance of the networking of theories. This multifocal lens is something more than a collection of different analytic tools, because the foci of data analysis are intertwined with theoretical perspectives. When researchers employ a multifocal lens on analysis, they can relate contributions from multiple analytic methods to illuminate new dimensions of a phenomenon.

A multifocal lens to explain complexities in students' reasoning

In a survey of recent research on students' mathematical thinking, Goos and Kaya (2020) note the increase in theoretical perspectives as the field has grown. They point to the networking of theories as a promising approach to address coherence amidst diversity in theoretical perspectives. To illustrate how a multifocal lens on data analysis can explain complexities in students' reasoning, we look at an empirical study from Johnson et al. (2020). First, we describe the setting of the study and discuss the theories networked. Second, we describe their data analysis methods, and insights gleaned from their approach. Third, we draw connections between theory and method.

Networking theories to investigate students' conceptions of what graphs represent

Johnson et al. (2020) conducted a qualitative study investigating high school students' conceptions of what graphs represent. There were 13 students in the study; each participated in a series of three individual task-based interviews. Students interacted with digital task sequences, and Johnson served as the interviewer. The digital tasks consisted of an animation of a situation, followed by a series of screens in which students could vary one attribute, then another, then both together. Students then could sketch a graph to relate the attributes. For example, one task involved a situation where a toy car moves along a curved track. Near the track was a small shrub. Students were to focus on two attributes: the toy car's distance traveled along the track and the toy car's distance from the shrub. Students could vary each distance, then both together, then sketch a graph relating those distances. Students' work on these tasks served as a primary source of data.

In their study design, Johnson et al. (2020) networked two theories: Thompson's theory of quantitative reasoning (Thompson 1994, 2011; Thompson & Carlson, 2017) and Marton's variation theory (Kullberg et al., 2017; Marton 2015). To argue for the viability of networking the theories, Johnson et al. (2020) identified a key assumption underlying both: researchers and participants bring different perspectives to the research setting, and hence can have different, yet viable goals.

Thompson's theory focuses on students' conceptualizations of attributes as being possible to measure (Thompson, 1994, 2011). Thompson calls this kind of conception a quantity. Per Thompson's theory, a quantity is something more than a unit attached to a number (e.g., 5 "feet"); it is how a student conceives of the attribute itself. For example, a student may encounter a graph that relates two different distances. Employing Thompson's theory as a lens, researchers may investigate what distance means for students, how students might think about measuring distance attributes, or how students might conceive of relationships between different distance attributes.

Marton's theory focuses on students' discernment, or separation, of some feature from an instance of which it is a feature (Kullberg et al., 2017; Marton, 2015). Marton (2015) proposes conditions under which teachers or researchers may engineer opportunities for learners' discernment. First, juxtapose two features, such that each differs with respect to a certain aspect. Second, let one aspect vary, while the other remains invariant. Employing Marton's theory as a lens, researchers may investigate how students discern aspects of graphs, such as a variable represented on an axis.

Employing a multifocal lens to analyze students' conceptions of graphs: Johnson et al. (2020)

Johnson et al. (2020) employed multiple phases of data analysis, following Wolcott's (1994) process of description, analysis, and interpretation. In the first phase, they described what students sketched (or tried to sketch), how students explained their sketches, and students' physical motions related to their sketches. In the second phase, they coded for students' conceptions of what graphs represented. Codes distinguished conceptions of attributes as being possible to measure (e.g., a distance traveled by the toy car) from the physical objects themselves (e.g., the motion of the toy car). In the third pass, they interpreted students' shifts in their goals for graphing, appealing to the different theoretical lenses.

By analyzing for both students' conceptualization (Thompson's theory) and discernment (Marton's theory), Johnson et al. (2020) embraced pluralism in their analysis methods as well as their theorizing. With Thompson's theory (1994, 2011), they identified three goals for students' graphing, which they linked to different conceptions of what graphs represent. With Marton's theory (2015), they distinguished between what researchers intended for students to discern (intended object of learning), what was made possible for students to discern in the task setting (enacted object of learning), and what students discerned as a result (lived object of learning). Looking across both interpretations, a fourth goal for graphing emerged, what graphs should represent. This fourth goal helped explain why some students had persistent conceptions of graphs as representing aspects of physical motion in a situation (e.g., a graph will turn like the toy car).

Drawing connections between theory and method

In Wolcott's (1994) interpretation phase of analysis, researchers strive to make meaning from the data. One way to make meaning is to turn to theory. In Table 1 we show the theoretical lenses, guiding questions, and student goals for graphing (bold) from Johnson et al. (2020). The text in italics addresses how interpretations from different theoretical lenses informed each other in the data analysis. For instance, employing Marton's theoretical lens has illuminated why some goals for graphing are more stable than others.

In the empirical study from Johnson et al. (2020), there is a relationship of "mutual affordance" between theory and method, as put forward by Chan and Clarke (2019). Neither Thompson's theory (1994, 2011) nor Marton's theory (2015) prescribed analytic techniques to follow Wolcott's (1994) process of description, analysis, and interpretation. Yet, the analytic approach allowed for interpretation from multiple theoretical lenses. While Johnson et al. (2020) employed a multifocal lens in the interpretation phase of Wolcott's process (see Table 1), it is not the only possibility. For instance, Johnson et al. (2020) could have conducted parallel passes of description, analysis, and interpretation for each theoretical lens, then made connections across those passes.

Table 1: A multifocal theoretical lens on Wolcott’s (1994) interpretation phase of data analysis

Theoretical Lenses	Quantitative Reasoning Theory: Conceptualization (Thompson 1994; 2011)	Variation Theory: Discernment (Kullberg et al., 2017; Marton, 2015)
Guiding Questions	What are students’ conceptions of attributes? How do students conceive of what graphs represent?	What is made possible for students to discern? What do students discern?
Three Student Goals for graphing	(1) Graphs represent observable features of a situation. (2) Graphs represent change in a single attribute. (3) Graphs represent relationships between attributes.	<i>Researchers intended goal 3 for students. All three goals were enacted objects of learning. Only goals 1 and 3 became lived objects of learning.</i>
A fourth goal	(4) There are things that graphs “should” do. <i>Students’ notions of what a graph “should” represent can impact their graphing.</i>	

Discussion

Our aim was to address interplay between methods of qualitative data analysis and the networking of theories. We illustrated this interplay within Wolcott’s interpretation phase of data analysis, putting forward a multifocal lens on data analysis to be an affordance of theory networking. Looking at the empirical study from Johnson et al. (2020), we illustrated how a multifocal lens on qualitative data analysis can explain complexities in students’ reasoning.

We drew parallels between obstacles to mixing methods from qualitative and quantitative paradigms and networking theories in mathematics education. Researchers in both fields (Bikner-Ahsbahr, 2009; Bikner-Ahsbahr et al., 2019; Onwuegbuzie & Leech, 2005; Prediger et al., 2008) advocated for pluralism as a response to obstacles which framed challenges in terms of dichotomies (mixed methods) or competitions (mathematics education). With our discussion of Johnson et al. (2020), we intended to illuminate how pluralism can extend to both theory and method.

A look at researchers’ methods, in conjunction with theories and paradigms, can be a way to respond to challenges related to a quest for coherence in mathematics education. To attempt to account for some of the theoretical diversity among researchers investigating students’ mathematical reasoning, Goos and Kaya (2020) looked at methods employed across studies. Interestingly, they found the methods implemented to be less diverse than the theoretical perspectives employed. Furthermore, looking at methods helped them to draw connections between these studies, and earlier studies, conducted during an era in which there was less diversity in theoretical perspectives employed by mathematics education researchers. This approach dovetailed with Onwuegbuzie and Leech (2005), who recommended a focus on methods, rather than paradigms, to help to overcome perceived dichotomies between quantitative and qualitative methodologies. Although we limited the scope of this paper to qualitative data analysis, we believe

it could apply to quantitative and mixed methods as well. Future steps could include principles and/or typologies for methodological approaches in studies in which researchers network theories.

We put forward a multifocal lens on qualitative data analysis as an affordance of networking theoretical approaches. With such a lens, researchers could analyze data sources from different theoretical perspectives, addressing multiple “focal constructs” (Chan & Clarke, 2021) in a single study. With this approach, we aim to advance the scope and depth of data analysis techniques when researchers employ multiple theoretical perspectives in a study.

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