

NATASHA M. SPEER

ISSUES OF METHODS AND THEORY IN THE STUDY  
OF MATHEMATICS TEACHERS' PROFESSED AND  
ATTRIBUTED BELIEFS

**ABSTRACT.** In research on teachers' beliefs, a distinction is often made between what teachers state ("professed beliefs") and what is reflected in teachers' practices ("attributed beliefs"). Researchers claim to have found both consistencies and inconsistencies between professed and attributed beliefs. In this paper, methods and research designs typically used in studies of teachers' beliefs are examined. It is asserted that, in some cases, the perceived discrepancy between professed and attributed beliefs may actually be an artifact of the methods used to collect and analyze relevant data and the particular conceptualizations of beliefs implicit in the research designs. In particular, the apparent dichotomy can be the result of a lack of *shared understanding* between teachers and researchers of the meaning of terms used to describe beliefs and practices. In addition, it is asserted that it is inappropriate to classify any belief as entirely professed since researchers make various attributions to teachers through choices about data collection, theory, analysis of data, and presentation of findings. Moreover, the emphasis on classifying beliefs in this manner may be inhibiting researchers from developing a more comprehensive understanding of teachers' beliefs. Traditional and alternative methods are described, a data example is provided to illustrate the claims, and implications for future research are discussed.

**KEY WORDS:** mathematics teacher cognition, research methods, teacher beliefs, teacher practices

## 1. INTRODUCTION

### 1.1. *Overview and rationale*

This paper examines the use of "professed" and "attributed" as classifications in research on teachers' beliefs and practices. Beliefs about mathematics, teaching, and learning are often described as either professed or attributed (Calderhead, 1996; Putnam and Borko, 2000). In research on teachers, professed beliefs are defined as those stated by teachers, while attributed beliefs are those that researchers infer based on observational or other data. This distinction has become a fixture of research on teachers' beliefs. Researchers have found both consistencies and inconsistencies between professed and attributed beliefs, but few theories provide insight into these findings. Moreover, there have been few advances made to research designs, data collection, and data analysis methods used to study beliefs

that shed light on such findings. Given the relatively widespread use of these classifications and their role in research, they merit further attention. This paper provides an examination of this classification's strengths and limitations and an exploration of how it might be influencing research in teacher beliefs and practices.

I assert that in some cases, reported discrepancies between professed and attributed beliefs may in fact be the result of methodological artifacts and not an accurate reflection of the phenomena researchers seek to understand. In particular, reported inconsistencies may be the result of a lack of *shared understanding* among researchers and teachers about what descriptive terms mean and also a consequence of the lack of coordination between data on beliefs and data on practices in most research designs. In addition, I contend that it is inappropriate to classify any data on beliefs as purely professed. All claims about teachers' beliefs are, to greater or lesser extents, attributed to teachers by researchers.

In the next section, I situate this work in the larger area of research on teachers' beliefs and practices. The subsequent section contains a brief survey of literature on teachers' beliefs and practices, followed by descriptions of methods typical in this area of research. In Section 4, the professed and attributed classifications are described and I discuss how, in some cases, perceived inconsistencies may be a consequence of methods used in research. I then examine how other approaches to research, from other theoretical perspectives, relate to these issues. Next, I describe one alternative data collection method and analyze how it addresses the issues raised earlier. Section 6 contains data examples to illustrate the thesis of this paper and the final section is devoted to conclusions and potential implications.

### 1.2. *Situating the work*

As an object of inquiry, teachers' beliefs have received tremendous attention in educational research. The history of research in this area has been dominated by approaches that align most extensively with cognitive perspectives, and while recent developments include attention to a broader array of theoretical perspectives, studies with foundations in cognition still constitute the bulk of the research. In addition, designations of beliefs as either "professed" or "attributed" are features of research that as been conducted mostly within cognitive frameworks. For those reasons, much of the focus of this paper is on research done from cognitive perspectives. Researchers who advocate approaching the study of teachers' beliefs and practices from non-cognitive frameworks, however, have identified some important theoretical weaknesses and methodological shortcomings

of existing research. Some have also proposed alternative approaches to pursuing research questions to address these issues. Later in this paper, I describe these approaches and examine their relationships to weaknesses I identified in cognitive-oriented research.

Despite the relatively long history of research in the area of teacher beliefs and practices, there has been relatively little inquiry into the nature of assumptions underlying dominant theoretical and methodological approaches. The recent emergence of more diversity in the theoretical perspectives used to conduct research in this area is likely to make substantial contributions to discussions about theory, methods, and findings. Research in teachers' beliefs and practices may be poised to experience some substantial advances brought about by the challenges presented to dominant cognitive approaches.

At such a juncture, there are many ways in which progress in an area of research may occur. As has been the case in some fields, progress may occur through "paradigm shifts" where, in light of new ideas or data, dominant theoretical views and/or approaches to research are set aside in favor of new ones. In other cases, progress is more gradual, resulting from accumulation of knowledge that in turn informs modifications to existing theories and methods. As noted earlier, there has been only limited inquiry into the nature of theoretical underpinnings and associated methods. Without such inquiry, the incremental approach to advancing knowledge is unlikely to succeed. This paper contributes to this inquiry in three ways:

- by examining features of research done within dominant, cognitive theoretical frameworks and identifying weaknesses;
- by proposing modifications to traditional research designs and methods;
- by examining how this modified approach addresses the identified issues/weaknesses and how the approach relates to other approaches to research in this area.

It may turn out that incremental change leads to substantive advances, or that large shifts in the field are what end up generating substantial progress, or both. What I contend, however, is that whether advances occur incrementally or through large theoretical shifts in the field, and independent of what emerges as the dominant theoretical perspective, researchers have a responsibility to look forward to implications for future research and to also look back at prior research in an effort to understand limitations of earlier findings. The work presented here is intended as a contribution to these discussions and examinations of the interconnected nature of theory, methods, and findings.

## 2. WHAT IS KNOWN ABOUT TEACHER BELIEFS AND PRACTICES

Of the issues that have helped to define research on teacher beliefs and practice, most prominent are those related to definitions, classification, and categorization schemes. These features of research have shaped the design of studies and have contributed to the use of distinctions between professed and attributed beliefs.

### 2.1. *Overview*

From findings in teacher cognition and related subfields of educational research, it is apparent that many factors influence teaching practices (Borko and Putnam, 1996; Clark and Peterson, 1986). Teachers' subject matter knowledge, pedagogical knowledge, and pedagogical content knowledge are all important influences on teaching practices – so too are the curriculum in use, teachers' goals, and myriad social and contextual factors. Research suggests, however, that beliefs are one of the significant forces affecting teaching (Calderhead, 1996; Pajares, 1992; Richardson, 1996; Thompson, 1992). For example, understanding teachers' decisions requires understanding not only what knowledge teachers possess, but also how they decide what knowledge to invoke, when, and how. Those decisions are a reflection of what a teacher believes to be important and plausible (Pajares, 1992).

Others have focused on the situated nature of research on teaching and implications of this perspective for examinations of beliefs (Ernest, 1991; Hoyles, 1992). Some very recent contributions focus on beliefs as a construct that is manifested in the complex context of classroom interactions (Skott, 2001a,b). Another branch of research shifts the focus away from individual cognition and beliefs and to the socio-cultural contexts in which teaching and learning practices are co-constructed by participants (Barwell, 2003; Gellert, 2001).

### 2.2. *Definitions of "belief"*

Despite the prevalence of research into beliefs, there is considerable debate about the definition and characteristics of beliefs. Study of beliefs came about, in part, because other factors (most notably standard measures of teacher knowledge) failed to fully explain the nature of teachers' instruction (Ball et al., 2001; Begle, 1979). In addition, from studies of teacher cognition, researchers learned of the wide variety of factors teachers referenced when making instructional decisions, many of which could not be classified as knowledge. This has led to proliferation of terms and various uses

of "belief" to describe elements of teacher's cognition. Other researchers have noted this and described beliefs as a "messy construct" with different interpretations and meanings (Nespor, 1987; Pajares, 1992).

Much of this "messiness" stems from researchers' desires to distinguish between beliefs and knowledge. Pajares and other researchers have made such distinctions based on particular characteristics they claim only beliefs possess, sources of beliefs, and how beliefs are organized in memory (Calderhead, 1996; Nespor, 1987; Thompson, 1992). Researchers often claim that a unique feature of beliefs is their evaluative and affective nature. For example, people have information about practices (knowledge) and perspectives about merits of practices (beliefs). Beliefs are also thought to be episodic in nature and tied to people's particular experiences.

Although debate continues, definitions found in the mathematics education literature focus primarily on how teachers view the nature of mathematics, teaching, and learning. In this context, beliefs are defined as conceptions, personal ideologies, worldviews, and values that shape practice and orient knowledge (Aguirre and Speer, 1999; Pajares, 1992; Thompson, 1984, 1985, 1992). Researchers contend that, "beliefs are instrumental in defining tasks and selecting the cognitive tools with which to interpret, plan, and make decisions regarding such tasks; hence, they play a critical role in defining behavior and organizing knowledge and information" (Pajares, 1992, p. 325). Beliefs appear to be, in essence, factors shaping teachers' decisions about what knowledge is relevant, what teaching routines are appropriate, what goals should be accomplished, and what the important features are of the social context of the classroom.

More recent surveys of literature (Furinghetti and Pehkonen, 2002; McLeod and McLeod, 2002) conclude that no consensus of definition has emerged yet. Other researchers dismiss the utility of the construct of belief as it has been used by researchers and propose frameworks that either make use of other related constructs (e.g., beliefs-in-action, situated beliefs) or do not rely on such constructs at all (Ernest, 1991; Hoyles, 1992). Some researchers suggest that it may not be appropriate to seek a single, general purpose definition (Furinghetti and Pehkonen, 2002; Torner, 2002) and that "... concern over a precise definition of belief pales in importance compared with the issue of understanding the nature of teachers' thinking ... ." (Wilson and Cooney, 2002).

### *2.3. Belief categorization and classification*

Research findings often take the form of categorizations and classifications of beliefs (Ernest, 1985, 1988, 1989; Kuhs and Ball, 1986; Lerman, 1990; Prawat, 1992). Each categorization scheme differs, but they are all,

in essence, attempts to characterize the different beliefs one might hold about a particular issue. Some researchers seek relatively comprehensive classifications of as many of a teacher's beliefs as they find feasible. Others have chosen to center their investigations on a single category or small set of categories. Examples below are not meant as a comprehensive description of work of the field, rather they are meant only to be illustrative of the kinds of categorizations and classifications researchers have proposed. One of the striking features of work in this area is the plethora of categorizations schemes found in research reports. Beyond top-level categories, there are nearly as many sets of categories as there are researchers.

For beliefs about mathematics, some researchers have appropriated categorization schemes from philosophy of mathematics. For example, Ernest (1989) proposed different views of mathematics: problem solving, Platonist, and instrumentalist. The problem-solving view takes mathematics to be a "continually expanding field of human inquiry," where as in the "Platonist" view mathematics is a unified, static body of knowledge that is discovered, not created. In the "instrumentalist" view, mathematics is a collection of useful unrelated facts, rules, and skills. Other categorizations are derived from different views of the nature of mathematical knowledge. Lerman (1990), for example, sorts beliefs into two categories: "absolutist" and "fallibilist" views of mathematics. Holding an "absolutist" view entails believing that mathematics is a certain, value-free, and abstract entity. A "fallibilist," in contrast, contends that mathematics is an activity and a problem-solving process where truth is not absolute.

Beliefs about teaching and learning have also been objects of study. Kuhs and Ball (1986) summarized four views. The "learner-focused" view centers on the learner's personal construction of mathematical knowledge through active involvement in doing mathematics. The teacher's role is as a facilitator of student learning. The second view, "content-focused with an emphasis on conceptual understanding," focuses on the logical relations among mathematical ideas. "Content-focused with an emphasis on performance" is similar to the previous one in its focus on mathematical content, but emphasizes rules and procedural mastery. The fourth view, "classroom-focused," emphasizes classroom activity that is structured, efficiently organized, where teachers present material clearly and students practice individually.

Many researchers have proposed other categorization schemes (for reviews of such work, see e.g., Leder et al., 2002). Categories other than the ones listed earlier found in such work include, among others: beliefs about self and beliefs about self as a teacher (Calderhead and Robson, 1991), beliefs about purposes of school and processes of learning to teach (Bullough et al., 1991).

Some researchers have asserted that the appropriate unit of analysis for research in this area is something other than individual categories of belief. For example, Skott (2001a) proposed School Mathematics Images (SMIs) as a construct to capture teachers' beliefs related to mathematics teaching and learning. Teachers' SMIs involve "teachers' idiosyncratic priorities in relation to mathematics, mathematics as a school subject and the teaching and learning of mathematics in schools" (Skott, 2001a, p. 6). Other researchers have claimed that individual categories or several broad categories fail to hold explanatory power for teachers' practices and that what is needed instead are particular, context-specific "collections of beliefs" (Aguirre and Speer, 1999; Speer, 2000, 2001).

#### 2.4. *Relationships between teacher's beliefs and practices*

Once categorized by researchers, beliefs are sometimes compared with practices. In some cases, researchers found that teachers' beliefs were consistent with what was reflected in observations of classroom practice. For example, Thompson (1985) described Kay who viewed mathematics as a "subject of ideas and mental processes rather than a subject of facts" (p. 288). She also viewed the study of mathematics as "discovery and verification of ideas." Kay's beliefs were said to be consistent with Thompson's observations:

She frequently encouraged the students, in a rather persuasive tone, to guess, conjecture, and reason on their own, explaining to them the importance of these processes in the acquisition of mathematical knowledge (p. 289).

Inconsistencies between beliefs and practices have also been documented. Cohen (1990) provided a case analysis of Ms. Oublier, a teacher who believed she was implementing reform mathematics practices. Cohen, however, claimed that Ms. Oublier had in fact maintained very traditional teaching practices that did not reflect the sense-making advocated by the reforms. Similarly, Thompson (1984) described Lynn who believed mathematics instruction should encourage students to ask questions and participate actively in discussions. Thompson observed, however, that Lynn's practice consisted primarily of lectures followed by routinized seatwork. These practices, which severely restricted student participation and the opportunity to ask questions, were deemed inconsistent with Lynn's beliefs.

It is certainly plausible that teachers might state beliefs and behave in a manner inconsistent with those beliefs. There are, however, other potential explanations for these findings tied to methods and research designs that warrant consideration. With this section about features of findings as

background, the next section turns to issues of methods and describes how such findings typically come to be.

### 3. TYPICAL METHODS AND RESEARCH DESIGNS

#### 3.1. *Beliefs: Questionnaires, interviews, and observations*

Much of the work on beliefs is based on self-reports from teachers (for reviews, see for example, Richardson, 1996; Thompson, 1992). Through questionnaires and/or interviews, researchers build descriptions of beliefs expressed by teachers. Methods employed range from large-scale surveys to in-depth case studies. In some cases, prompts are used such as written or videotaped classroom scenarios.<sup>1</sup>

Belief data are often categorized based on schemes (such as the ones described earlier) which are sometimes derived empirically from data and other times predefined categorization schemes are used.

In some instances, beliefs teachers state are augmented with ones inferred from observations. Some researchers contend that for accurate portrayal of beliefs, “investigations of teachers’ mathematical beliefs should examine teachers’ verbal data along with observational data of their instructional practice or mathematical behavior, it will not suffice to rely solely on verbal data” (Thompson, 1992, p. 135). Typically, characterizations of particular beliefs (e.g., mastery of skills is important) are derived from behaviors observed that are considered consistent with holding that belief (e.g., devoting considerable class time to drill work on those skills). Methods used to attribute beliefs to teachers from observational data are not usually specified in detail. In addition, rarely are definitions of descriptive terms presented – it is assumed that the teachers, researcher, *and the reader* understand the terms to mean the same things.

As a preview of the issue of shared understanding that is discussed in a later section, consider for a moment what stating, “I believe groupwork is important” might mean to someone. One person might apply such a label to classrooms where groups of students are collaboratively constructing a proof. In another scenario, students are solving equations individually and checking answers with one another. Someone else might classify this second episode as groupwork. A multitude of other scenarios might be considered “groupwork” by someone and there is no guarantee that the term evokes the same images for teachers, researchers, and readers, yet it

<sup>1</sup>From reviews of the literature (e.g., Leder and Forgasz, 2002) it appears, however, that most prompts are manufactured and not derived from actual practices of teachers participating in the research.

(and similarly under-specified terms) are often used during research and in reports of findings.

### 3.2. *Practices: Observations and teacher self-reports*

Data on teaching practices typically come from two sources: observations and teacher self-reports (Calderhead, 1996; Thompson, 1992). Observations are sometimes documented on videotape or audio recorded. Field-notes or more structured systems for recording observations are common among written data-gathering methods. In most cases, these studies provide little detail about methods used to analyze observational data and descriptive terms are often used without accompanying definitions.

In some cases, data about instructional practices come not from observations but instead from teacher self-reports. In these instances, teachers are asked to describe their classes or are queried about their use of specific teaching practices. Specifics about methods and definitions are not usually provided. Consider the kinds of activities taking place in classrooms matching the description, "The teacher led a discussion about problem solving." Someone might use that to characterize presentation of techniques for factoring necessary in solving linear equations. Others might reserve such a description for scenarios where the teacher acted as a facilitator as students offered and critiqued different approaches to solving equations. The particular features of situations characterized as "problem solving" might vary considerably from one person to the next. The use of this kind of descriptive term might mean one thing to a researcher conducting an interview and something very different to the interviewee.

Using data collected in the manner described earlier, some researchers examine relationships between teachers' beliefs and their in-class teaching practices. Typically, researchers look for correlations among beliefs and observed or reported practices. As with some of the methods described earlier, how these analyses are conducted is often described only in very general terms. There are other methods for documenting teacher practices emerging in the research community that provide alternative and additional sources of data for connecting beliefs and practices. These are discussed in Sections 5 and 6.

## 4. PROFESSED AND ATTRIBUTED BELIEFS AND CHARACTERISTICS OF RESEARCH

In this section, I present my three central claims about methods used in research on beliefs and practices. As noted earlier, researchers have found

both consistencies and inconsistencies between beliefs and practices. This has led to separate classifications of what teachers say (professed beliefs) and what is reflected in their practice or inferred from other data (attributed beliefs) (Calderhead, 1996; Thompson, 1984). These classifications have influenced the research designs and methods used in studies of teachers' beliefs and practices.

My claims are as follows:

- The distinction between professed and attributed beliefs is a false dichotomy, and in some cases, reported inconsistencies may be the consequence of a lack of *shared understanding*. Therefore, research designs should incorporate opportunities to assess and generate shared understanding in studies of beliefs and practices.
- If the objective of a study is to examine the role of beliefs in shaping teaching practices, data on beliefs must be obtained in conjunction with data on the practices that one seeks to understand.
- It is inappropriate to classify any belief as entirely “professed” because all beliefs are, to some extent, attributed by researchers. Reliance on this classification in the design of research may be obscuring the very phenomena researchers seek to understand.

In this section, I first explore other researchers' explanations for professed – attributed beliefs differences and then I examine my three claims and their relationship to research findings about beliefs and practices.

#### 4.1. *Proposed explanations for professed – attributed belief inconsistencies*

There are many possible explanations for perceived inconsistencies between beliefs and practice and other researchers have presented some potential reasons for such findings (Ernest, 1989; Wilson and Cooney, 2002). Ernest's (1989) proposed causes all appeal to characteristics of teachers and contexts: lack of connection between the professed belief and the teacher's other beliefs and knowledge; extent to which teachers have reflected upon and integrated beliefs with practices; influence and constraints of social contexts on the enactment of beliefs. Wilson and Cooney (2002) suggest that the answer may lie in the “practical or logistical circumstances” of teaching that prevent teachers from acting in accordance with their beliefs (p. 131). Alternatively, the explanation might lie in the structure of beliefs and the relative force that other beliefs might have over the one in question. None of these explanations point to methods of research and their potential influence on findings.

Wilson and Cooney, however, also suggest that discrepancies may appear when researchers “do not have a viable interpretation of what the teacher means” by various terms (p. 130). Exploring such explanations, however, was not the focus of Wilson and Cooney’s (2002) paper. In this section, I build on this work, examining this potential methods-related explanation in detail.

#### 4.2. *The potential role of shared understanding*

It is quite plausible that there are situations where teachers state beliefs that are (intentionally or unintentionally) inconsistent with what they carry out in their classrooms. It is possible, however, that perceived discrepancies are sometimes the result of incomplete or inaccurate understanding of terms and descriptions used by teachers and researchers.

These issues of attribution are further complicated by the potential of researchers and teachers to mean different things when using the same descriptions. As noted earlier, primary sources for information about teachers’ beliefs include questionnaires and interviews. On questionnaires or in interviews, terms used by researchers to describe beliefs and practices (for example, “problem solving,” “cooperative learning,” “sense-making,” etc.) may not carry the same meaning for teachers as they do for the researchers. When a teacher says she believes she should foster “sense-making” of mathematical ideas in her classroom, can researchers be certain they know what the teacher means? When researchers ask teachers what they believe the role of problem solving should be in their classes, how certain can they be that they and the teachers have similar understandings of what problem solving is? This disconnect, or lack of *shared understanding*, between teachers and researchers means that resulting data may not accurately represent teachers’ beliefs or practices and may shape findings and conclusions in significant ways.

This issue of shared understanding is also problematic when researchers make attributions of belief based on observations of practice. A typical example begins when a teacher states a belief (for example, “Problem solving is important”). Next, the researcher observes as the teacher has students work a series of procedural exercises – a practice the researcher does not see as reflecting a belief in the importance of problem solving. The researcher concludes that there is an inconsistency between what the teacher claims to believe and what she must really believe. The problem lies again in the presumed shared understanding. What the teacher did in the class may fit *her* conception of problem solving, and the teacher and the researcher may merely hold very different definitions.

Examples of this phenomenon can be found in Cooney's (1985) study of a teacher named "Fred" and Cohen's investigation of Ms. Oublier (Cohen, 1990). In the case of Fred, from the researcher's perspective, his instructional practices did not reflect beliefs about the importance of problem solving. The source of at least some of the conflict, however, was that "the meaning he held for problem solving was limited" (p. 333). In a similar fashion, Ms. Oublier's professed beliefs about elements of reform-oriented instruction were not evident in observations of her practice but that could have been because of her understanding of the descriptions of reform.

Saying these teachers' practices do not reflect the *researcher's* conception of particular terms (e.g., problem solving or reform mathematics instruction) is not the same as saying that their beliefs and practices are inconsistent. Unfortunately, methods typically used to do not make it possible to distinguish between situations where there really are discrepancies between what teachers' believe and how they teach and those where discrepancies are between researchers' and teachers' definitions of descriptive terms.

To address these issues, design of research should acknowledge the possibilities of people holding different conceptions of terms and methods should provide researchers' with access to teachers' definitions of the terms they use to describe their beliefs and practices.

#### 4.3. *Practice-based belief data*

In much of the research that examines connections between beliefs and practices, data are collected separately on beliefs and on practices, and then during data analysis, relationships are investigated between the two data sources. As other researchers (e.g., Hoyles, 1992) have asserted, I contend that beliefs are situated in particular contexts. I also assert that if the objective of the research is to make claims about practices, data on beliefs should come from sources that are tied to the particular practices that one seeks to understand. Instead of beginning with data collection about beliefs and then analyzing data on practices in light of the finding about beliefs, one can begin with practices and gather data related to beliefs in connection with those practices and contexts.

Teachers may or may not exhibit consistency in their beliefs from one context to another. Much of the prior work on beliefs and practices has presumed that such consistency existed and design of methods took such consistency as given. It seems, however, more productive to begin with the phenomena one is interested in (teaching practices) and design methods to examine the beliefs that influence those practices. Once we can be more certain about how robust findings are that connect belief with practices,

questions about the presence of consistency (and the characteristics of situations across which it is found) can be more fruitfully explored.

#### 4.4. *All beliefs are attributed*

Using the term “professed” to describe beliefs also gives an inaccurate impression of the nature of the data. When teachers make statements of belief, researchers shape how the data are portrayed. Even in cases for which transcript or other teacher-generated statements are used as data, researchers have framed the presentation of the excerpt and provided surrounding prose that shape how the teachers’ beliefs are portrayed. This is an inherent trait of qualitative research and in no way unique to studies of teachers and teaching. The consequence is, however, that all beliefs reported are attributed, at least to some extent, to teachers by researchers.

It seems that implicit in the design and use of traditional methods is an assumption that such work is a relatively low-inference endeavor. It appears, however, that finding connections between teachers’ beliefs and their instructional practices actually involves many levels of inference. Instead of designing methods just to access attributed and professed beliefs separately, it seems more productive to devise methods that allow for the *most accurate attributions possible*. In a later section, a particular kind of interview is described that was designed to obtain data that would allow for more accurate attributions of belief that are possible with traditional methods.

## 5. OTHER THEORETICAL PERSPECTIVES

As noted in the opening section, other researchers have identified various theoretical and/or methodological issues with research on teachers’ beliefs and practices and have approached the challenges of understanding the relationship between teachers’ beliefs and practices from non-cognitive perspectives. Some researchers have even questioned the sensibility of pursuing questions about belief at all and have proposed other frameworks for investigating teachers and teaching practices. While some recent perspectives on and approaches to research in this area have questioned the validity and robustness of prior findings, the theoretical and methodological tenants of these perspectives have yet to address all of the weaknesses I perceive in this area of research. In this section, I provide an overview of some contributions to work in this area – in particular, contributions from an interactionist perspective and work from discursive psychology. The presentation includes analyses of the relationship of these approaches to the

issues I have raised about the nature of research in the cognitive-based approaches described earlier.

### 5.1. *Interactionist perspective*

Instead of viewing beliefs as static traits of a person that remain constant across situations, from an “interactionist’s framework, beliefs are viewed as “entities that may be transformed or even emerge in and as a result of his or her interactions with students” (Skott, 2001b). From this perspective, it is deemed inappropriate to describe teachers as inconsistent – “inconsistency is an observer’s perspective that does not do justice to the complexity of the teacher’s tasks” (Skott, 2001b). Research based in this framework questions the role of such beliefs in shaping teachers’ practices, saying that typical characterizations of teachers’ beliefs may or may not match what is observed at any particular moment, but that is not because there are inconsistencies between beliefs and practices. Instead, while school mathematics images or beliefs, as captured in typical characterizations play a role in teachers’ practices, they are not necessarily the sole determinant. Additional factors, or teachers’ priorities for things other than mathematical content, are seen as influencing practices and sometimes overshadowing the role of mathematics-specific beliefs.

While work conducted within the interactionists’ framework (e.g., Skott, 2001a,b) contributes insights into the nature of teachers’ practices and the roles of beliefs in shaping those practices, such work does not speak directly to the weaknesses of this area of research that were identified earlier. For example, this perspective does not directly address the issues of classification of beliefs as professed or attributed. A mix of sources for beliefs is utilized (questionnaires, interviews, as well as discussions of classroom episodes) and studies utilize beliefs, as they emerge in interaction, as the focus of analysis. Although not explicitly described as such, these data are treated as data on professed beliefs.

The interactionists’ perspective does place high value on examining beliefs as they relate to actual examples from participating teachers’ practices. This addresses one concern raised earlier, namely the need to utilize data that is inherently tied to practices if the objective is to make claims about factors that shape those practices. In some of the work, however, the focus is on comparisons between belief characterizations generated from questionnaires/interviews and beliefs as they emerge in interaction in classrooms. The claim is that the former characterizations of beliefs are still a valid, although incomplete, framework from which to examine practices (albeit supplemented with additional data on beliefs that emerge during interactions).

Although data on beliefs are collected in conjunction with episodes from participating teachers' practices, no explicit intention is made to build shared understanding of descriptive terms. It is possible that researchers working within this framework are also structuring interviews so that definitions and characterizations emerge during the discussion, but no specific attention to this issue appears in descriptions of the methods or theoretical framing.

### 5.2. *Discursive psychology perspective*

Another theoretical perspective comes from the "discursive" branch of psychology. Typical studies from cognitive-based perspectives focus on describing participants' beliefs and using those as frameworks for examining systematicity in participants' actions in the classroom. In contrast, "discursive psychology reflects upon descriptions, explanations and justifications given in the course of a talk or a written report" (Gellert, 2001, p. 35). The assertion is that, "interpretation is at the level of public interaction, rather than the private realm of the mind. Thus, rather than attempting to make sense of what people know (in their heads), discursive psychology focuses on how issues like knowing are dealt with by the participants *themselves*" (Barwell, 2003, p. 203, emphasis in the original). Research conducted within this framework has examined student-teacher interactions in classrooms (Barwell, 2003) as well as interviews with teachers about their beliefs (Gellert, 2001).

While this perspective provides alternative ways of approaching the challenge of understanding what teachers do and why, it does not fully address the issues raised earlier. This may be in large part because the discursive perspective pursues questions and findings that are very different from those within more cognitive-oriented frameworks. Findings represent participants' discursive practices as they occur in interviews or in interaction with students.

The discursive perspective advocates a move away from examining anything that must be attributed to the participants by the researcher. Since "the attitude categories used by the observer to classify the interviewees' utterances may tell us more about the observer than about the interviewees" (Gellert, 2001, p. 35), the focus is instead on only what participants profess. While proponents of this perspective admit that, "At some level analysts . . . must introduce some level of external categorizing or labeling . . .," and that, "It is not possible to remove analysts entirely from their analysis," (Barwell, 2003), there does not seem to be (in my opinion) adequate acknowledgement of the role that even limited attribution might have on research findings. Any "external categorization or labeling" is, by definition,

contributed by the researcher and hence, even researchers operating within this framework are making attributions to teachers during analysis.

In some incarnations, research conducted from a discursive perspective is based in the practices of teachers and in other cases it examines interview data. Since the research is not focused on finding relationships between beliefs and practices, but is instead centered on representing participants' discursive practices, there is no need to tie beliefs to particular instances of practice. In the cases where the object of analysis is a classroom interaction, the focus is on the data of the practice and the resulting analysis is therefore tied more closely to the practices than is often the case in research conducted from other perspectives.

This perspective, however, does not place an emphasis on developing shared understanding of terms or definitions as used by the participants and researchers. The objects of study are the participants' statements and the goal is to represent those statements from the participants' points of view. The validity of this process is supposedly assured by the "public" nature of the discourse as opposed to the "private" realm of individual cognition. Since objects of analysis are participants' utterances and analysis does not involve the introduction of categories by the researchers, it is presumed that having shared understanding is not necessary. I contend, however, that researchers are still basing their analyses on their understanding of what participants mean by words used in discussions. As a result, there is still the possibility that some findings may be colored by researchers' understandings of particular terms that may or may not be shared by the participants.

Both the interactionist and discursive perspectives illuminate features of traditional approaches to research on beliefs and teaching practices that are worthy of attention. While both provide viable alternatives to the cognitive-dominated research tradition, neither was proposed as a means for addressing the specific methodological issues raised earlier. As a consequence, neither provides remedies to all of these issues. In the next section, I describe one approach to research on beliefs and practices that was designed expressly to address the issues raised earlier.

## 6. DESCRIPTION OF ALTERNATIVE METHODS

From the overviews given earlier, it appears that both methods and theoretical perspectives have shaped the designs of studies and resulting findings on teachers' beliefs and practices. While many important and interesting issues related to theory merit attention, this section focuses on

methods and one design of research that addresses the issues identified earlier.

Ideally, researchers need methods that generate data from which one can make the best attributions and that are connected to practices. Teachers' reflecting on their own practice is one approach. Videoclip interviews, the focus of discussion here, are an example of a method based on this principle. This method is, however, just one example. It is likely that the issues identified earlier could be addressed in a variety of other ways, especially if different theoretical perspectives were adopted. Here, however, emphasis is on addressing the issues by providing alternatives to methods typically used in cognitive-inspired studies.

### 6.1. *Videoclip interviews*

Since work on beliefs is highly dependent on descriptions and terms used by researchers and teachers, to improve the accuracy of attributions, there must be an increase in the likelihood that teachers and researchers have shared understanding of terms used to describe beliefs and practices. The presence of shared understanding needs to be checked during the data collection process. If it comes to light that the researcher and teacher are using terms in different ways, methods need to enable the researcher to have access to the teacher's meaning for the terms.

With the advent of new technologies, researchers can now consider methods other than those traditionally used – ones that combine aspects of the observation portion of research with the teacher interview portion. One such method checks for and builds shared understanding between researchers and teacher by videotaping classes and using the video data as the context for "videoclip" interview.

This videoclip interview technique was based in part on other researchers' use of "videoclubs" as a professional development activity and as a source of data on teacher cognition (Frederiksen et al., 1998; Nathan et al., 1998; Sherin, 1996, 2002). By using videoclips of teachers' classes in interviews, it is possible to obtain information beyond what is possible in traditional, de-contextualized interviews or in a combination of interviews and observations. As described later in this section, in addition to making it possible for researchers and teachers to generate shared understanding of terms, this method also addresses two other issues. Videoclip interview methods enable researchers to collect data on beliefs tied to specific examples of teachers' practices and data is generated that permits more accurate attributions of beliefs. For a more detailed descriptions of these methods and rationales for their use, see Speer (2001).

## 6.2. *Interview preparation procedures*

After a class is videotaped, the researcher views the videotape and selects excerpts for discussion with the teacher. As with any interview, design is an inherently theory-laden process. The selection of excerpts, as well as the choice of questions, are all shaped by (and are a reflection of) the researcher's particular theoretical perspective. A researcher may be generally interested in the role beliefs play in instructional practices. In that case, excerpts might be selected that represent the instructional interactions typical of teachers' classes. If instead the researcher is interested in the kinds of questions teachers ask, excerpts might be selected to represent the variety of questions teachers pose. Alternatively, a researcher might be especially interested in what happens when students provide incorrect answers and excerpts that include this situation would be selected. And so on.

After excerpts have been selected, the researcher uses them as prompts during the interview. The teacher is asked to explain what he or she was doing during the excerpt and why. As discussed below, the use of video-clips can help check for, and if necessary, build shared understanding by allowing vocabulary to emerge and by providing a meaningful context for the discussions. By shared understanding, I mean that participants have had opportunities during interviews to share their meanings of particular descriptive terms and to connect them with examples from their practice as captured on the videotape. If the participant's definition does not match the researcher's, the researcher can then (for the purposes of the interview and data analysis) adopt the participant's definition of term. Then the researcher can use descriptive terminology and be relatively certain that terms mean the same thing to the participant.

An alternative to this approach could entail both the researcher and participant sharing their understanding of various descriptive terms and then agreeing to a particular meaning for the terms. While this approach might be useful in some circumstances, it seems that some participants might feel that the researcher's definition of a term is "correct" (given the researcher's presumed authority on education). The participant might then agree to using the researcher's definition even if it is not the definition the participant has in mind. Instead of introducing this potential complication, I chose to adopt the participants' use of terms when a difference in our definitions was apparent.

The data examples come from a project in which research questions centered on teachers' use of questions and their problem-solving support practices. In the particular, the focus was on teachers' questioning practices and the nature of support teachers provided as groups of students worked collaboratively on mathematical problems in undergraduate calculus classes.

This focus influenced the excerpts that were selected as well as the kinds of classroom interactions that were analyzed. Specifically, analysis focused on three kinds of interactions that were most prominent in the classes: discussions with groups when they had completed a problem correctly; situations when the teacher detected an error in students' work; and instances when students were struggling with a problem.

Within each category of interaction, several kinds of episodes were used in the interviews with the teachers. The rationale for selecting particular episodes as well as the nature of the questions asked during the interviews has many of the features of "convergent interviewing" (Dick, 2000). Episodes were selected that were *representative* of the teacher's common ways of interacting with students. For example, if the teacher consistently began interactions by asking students to explain their solution, episodes of this practice were selected. As data collection and analysis progressed, while viewing tapes it became easier to correctly hypothesize reasons teachers would give in the subsequent interviews for their decisions. Episodes where it was challenging to make such predictions (*outlier episodes*) were selected since they indicated there were aspects of the teacher's practice and beliefs that were not yet fully understood. Episodes were also selected from classes when students were being introduced to a new topic as well as when they had been working with a topic for awhile and were engaged in more complex problem solving. By choosing these *content variation* episodes, different types of teaching practices were captured and these contrasts were used as a means for further investigation into beliefs. In addition, episodes were chosen when different groups of students were working on the same problem. These *comparison and contrast* episodes include instances when teachers appeared to be interacting with groups of students in substantially different ways or in similar ways. The discussions of such comparisons and contrasts generated especially rich and detailed data. Episodes were also used of instances where the teacher was interacting with the same group of students on multiple occasions as they worked on one problem (*trajectory episodes*). Having these sets of episodes enabled the teachers to be questioned about whether their decisions in the different episodes were based on the same or different factors.

### 6.3. Interview procedures

Prior to each interview, videoclips were selected for discussion according to the criteria described earlier. The interviews did not follow a rigid script; they were opportunistic, rather than following a structured script, allowing the flexibility to pursue issues raised by teachers as they discussed each

videoclip. Discussion of each videoclip addressed the following questions, among others:

- What did the teacher want the students to get out of doing this problem?
- What happened in this episode (from the teacher's perspective)?
- What was the teacher trying to accomplish?
- Why was the teacher trying to accomplish that in particular?

Before watching an episode, the teacher was asked what they hoped the students might get out of problem. This generated data on objectives of the problem in the teacher's own words. This information helped contextualize the rest of the discussion.

After a videoclip was played, the teacher was asked to describe what had happened in the interaction. Since most of the clips were only a few minutes long, it was usually possible for the teacher to "narrate" what had happened during the entire clip after it was played. At the beginning of the set of interviews, teachers had to be prompted for this information, but they quickly got into the routine and more often than not, they would start talking immediately after the clip ended. These "narratives" provided data on what happened in the episode from the teacher's perspective and helped ensure that analysis was not based only on the assumption that the researcher "saw" the same things in the episode as the teacher.

As they narrated the clip, additional questions were asked to probe and clarify what they were trying to do and why. They were asked to describe particular decisions as well as their reasons for their choices. This approach enabled belief-based decisions to be closely tied to specific instructional decisions as captured on the videotape.

#### 6.4. *Emergent definitions and vocabulary*

In traditional interviews, researchers might ask, "What role does problem solving play in your teaching?" Terms such as "problem solving" do not have precise, universally agreed upon definitions. Researchers should not assume teachers (or other researchers or readers) share definitions. Videoclip interviews make it possible for the descriptive vocabulary and definitions used to emerge in the context of the conversations and be inductively derived from the discussions.

In a videoclip interview, a teacher can describe what was going on in his or her own terms. Instead of introducing words into the discussion with potentially ambiguous meanings, words come from teachers. For example, when asked to describe a videoclip, teachers provide the researcher with descriptive terms that have meaning for them. This comes with the obvious

caveat that the researcher must seek to understand what the teachers mean by the words they use – a task made easier with the use of actual examples of classroom practices as discussed below.

### 6.5. *Shared artifacts and increased connections to practice*

Videoclip interviews improve shared understanding by utilizing shared artifacts that ground interviews in examples of teachers' practices. Instead of discussing beliefs and teaching practices in the abstract, videoclips provide concrete contexts around which discussions can be focused.

In de-contextualized interviews, researchers might ask about questioning practices. Interpreting teachers' responses might be challenging because of the multiple layers of inference needed. For example, the teacher had to interpret what the researcher meant by "questioning practices" and then the researcher had to interpret the teacher's response to the questions. A more complete understanding of what teachers and researchers mean when using particular words is possible if those words are tied to actual examples of practice. Although there is certainly still inference necessary in a videoclip interview, the videoclip provides a concrete example to build questions around and to make reference to in the discussion. The researcher can then match terms as understood by the teacher to illustrative examples and create a more accurate and complete understanding of what he or she means when using particular terms. These features of videoclip interviews make it possible to generate more accurate attributions than are possible with traditional interviews and observations.

## 7. DATA EXAMPLES

In this section, claims about professed and attributed beliefs and the importance of checking for and establishing shared understanding are illustrated with data examples. The teachers are Karl and Zachary, both doctoral students in mathematics at a large public university in the United States. During the study, both were teaching calculus courses where substantial class time was devoted to collaborative groupwork. First, Karl and Zachary's beliefs and practices are described as they might be obtained using traditional methods. Viewed in this manner, there were inconsistencies between what each professed to believe and the beliefs that might be attributed to them based on observations of their teaching. From videoclip interview data, however, it was possible to develop a more thorough profile of their beliefs and the apparent inconsistencies were

resolved. The focus here is on illustrating the claims and only a few of each of their beliefs are discussed. These examples are drawn from a larger study of teachers' beliefs and practices (Speer, 2001).

### 7.1. *Findings from traditional methods*

In this section, findings are presented from traditional use of interviews, observations, and data analysis of Karl and Zachary's beliefs and practices.

#### 7.1.1. *Karl*

Analysis of interview data not connected to video clips revealed that Karl believed he should promote "independence" in his students. He believed it was important that students learn to solve problems in their groups without relying on extensive assistance from him. He said, "There's some sense of independence you're trying to get them, I'm trying to get them." He said this was "... because they're not always going to be in a nice, structured class where there's somebody who knows more than them. I mean at some point they're going to be in a situation where nobody can tell them what the answer is, nobody can tell them what the reason is."

In support of "independence," Karl believed students should figure things out for themselves and that his primary mode of interaction with them should be to ask questions to help them solve problems on their own. Karl described his role in class as, "Socratic. I mean, it's, it's, they know that *I* have the answers. It's like everybody, you know, I've got the answers for it, I'm not going to tell them. But I'm going to try to ask them and see if I can get *them* to figure it out by asking the right questions." Karl also believed mathematics was about ideas and relationships and felt that in addition to developing skills, students needed to understand mathematical concepts.

Inferences from observations, however, might lead one to conclude that there were inconsistencies between Karl's professed beliefs and what could be attributed to him. Karl's manner of interacting with students did not reflect the idea of independence in the ways one might have expected. He did have students work on problems, but he did not provide very substantial scaffolding or problem solving support. His professed beliefs would lead one to expect a questioning style that drew out student ideas and helped them build on their existing understanding of the material. Yet, although he did ask many questions, he did not probe for student understanding or illuminate the mathematical ideas and relationships he professed to value. For example, he frequently asked very general questions such as, "What does the problem ask?" and "What should you do next?" When students were unable to answer, he neither asked more specific questions to bring

out what the students did not know nor directed them to relevant features of the problem. He typically just repeated the same non-specific question he had asked initially. His use of questions rarely helped students make progress and were not what most would categorize as "Socratic."

#### 7.1.2. Zachary

Analysis of interview data independent of videoclips revealed Zachary's belief that effective learning takes place when teachers act as guides for students while creating a comfortable classroom environment. When asked about his teaching practices, Zachary said, "I sort of see my role as like, educational guide." When asked to elaborate, he said, "You know, I want to feel like, I want them to feel like, I'm an intellectual resource or guide." He said that part of this role involved helping students as they solved problems and providing information to them when they were struggling. In addition to acting as a guide, Zachary believed it was important to create a particular kind of atmosphere in his classroom. While describing the groupwork portion of class, he said, "[It] is to just create a comfortable and friendly atmosphere." He also said that he thought it was "... good for them to feel like they have somebody on their side."

From what Zachary professed during interviews, it appeared he believed it was important to guide students through problems and act as "an intellectual resource" of information. These beliefs, combined with his views about the importance of a comfortable classroom atmosphere, could imply that in Zachary's classroom students receive help from him whenever they encounter something they do not know or are faced with a problem they are unable to solve. Given his beliefs, it might also be inferred that he would provide rather specific information or suggestions to students as they worked on problems so they would not be uncomfortable and the friendly atmosphere could be maintained.

It would be easy to conclude that there were significant inconsistencies between his professed beliefs and what could be attributed to him based on observations of his classroom. Zachary's instructional practices did not involve "guiding" students to solutions to problems in the ways that might be inferred from what he said during interviews. When students were having difficulty with a problem, Zachary did not tell what the next step should be or point out what their mistake was. Instead, without fail, he asked them to explain what the problem was asking and to describe what they had done so far and why. In addition, while the classroom atmosphere was pleasant, Zachary sent clear messages about the intellectual work to be accomplished and his high expectations for students – practices that are not necessarily what one might infer from his professed description of being "somebody on their side."

## 7.2. *Findings from videoclip-based methods*

When data from videoclip interviews were used, analyses of data revealed what Karl and Zachary meant by terms they used and the perceived inconsistencies between their professed and attributed beliefs were resolved. The shared artifact of videoclips of Karl's and Zachary's actual practices enabled a richer understanding of their beliefs and teaching practices to emerge.

### 7.2.1. *Karl*

To Karl, asking the kinds of questions he asked and interacting with students in the manner he did were both consistent with his beliefs about promoting independence. He believed that to promote independence, students needed to learn to ask themselves a set of "stock" questions. He also believed the main obstacle preventing students from solving problems was their failure to ask themselves these questions. He said, "Often when I asked them these questions, I try to ask the same questions enough times that they start getting it in their heads that these are good questions to ask themselves." He went on to say, "I try to always have kind of a stock set of questions, so that after awhile they start hearing the questions in their own head." He said that the questions were the main thing that would help students learn to be independent and he added, "Especially, especially the more general questions."

Although as an outside observer, one might not infer Karl's belief in "independence" from his use of questions, Karl believed he was helping students learn to be self-reliant and solve problems on their own. To Karl, the general questions he used were completely aligned with his conception of "Socratic."

From these and other discussions with Karl, it was possible to clarify what he meant by the terms he used. Not only did "promoting independence" have a different sense than one might have expected, but so did his concept of "Socratic questions," and other descriptive terms he used. Once these meaning emerged, there was no longer any inconsistency between his professed beliefs and what one might attribute to him from observing him teach.

### 7.2.2. *Zachary*

With Zachary, the key to resolving the perceived inconsistencies was unpacking his meaning of "guide." To Zachary, "guiding students" meant asking them questions to help them think about the problem so that they could devise a solution on their own. When we discussed videoclips where he was interacting with students in these ways, he was very explicit that his role

was not to guide the students to a solution by telling them what they should do next or by identifying the particular mistakes they had made. To explain the decisions he made on a particular videoclip, he made an analogy between his mathematics classroom and a local interactive science museum. He equated solving the mathematics problems with understanding how a science exhibit at the museum worked:

So they're there at the [interactive science museum] messing around with stuff and they get some machine that's supposed to do something and they're trying to make it go and they can't figure out how it works so they call me over and I try to like step back and ask them, 'What's this machine supposed to do?' And they like try to tell me about the theory of it and . . . I won't want to say like 'Here's this button, you need to push it.' I want to make them say, 'There's supposed to be a button that I need to push.' I'm like, 'OK, well where is it?' And then they're like, 'Oh if I look very closely I can see where it is.'

In describing his role as guide more generally, he said, "It's their [the students'] job to do the traveling and I can maybe just shine a light in the correct direction." While his use of the word "guide" fits well with these more detailed descriptions that emerged from discussion of the videoclips, this particular definition is not necessarily what might have been inferred from his earlier use of the term in the de-contextualized discussions about his beliefs.

Based on these brief illustrative data examples, many questions remain, of course, about the nature of Karl's and Zachary's beliefs and their relationships to practice. The purpose of these examples was to demonstrate how a particular approach to data collection and analysis can generate findings that might not have been possible with other methods.

The brief examples also do not address various issues related to Karl's and Zachary's beliefs and practices that might be of interest to some educational researchers or providers of professional development. For example, from these examples, one cannot know how effective Karl's or Zachary's practices are in creating rich opportunities for students to learn. The merit of their beliefs and practices is, in the end, a value judgment tied to one's own beliefs and goals related to mathematics instruction. In addition, one cannot know the extent to which Karl or Zachary are committed, over time, to the particular views of teaching and learning presented in this example or even the extent to which either is capable of reflecting on his beliefs and practices. In addition, one is also not privy to how Karl's and Zachary's beliefs and practices as presented in this example developed in the first place. Addressing these interesting issues and others, however, is beyond the scope of this paper.

## 8. CONCLUSIONS AND IMPLICATIONS

I now return to the three main claims and examine them in light of the findings from the studies of Karl and Zachary. Recall the first claim: methods used to examine beliefs and practices, in some cases, may be the source of perceived inconsistencies between professed and attributed beliefs. As illustrated with the data samples earlier, the data collection methods selected can influence relationships found between beliefs and practices – in some cases, potentially leading to findings that are not accurate portrayals of the situations. The current findings suggest that researchers need to be careful when making claims about consistencies and inconsistencies between beliefs and practices and need to select methods that ensure that the methods are not biasing the findings in one way or another.

There are also implications for theory. Various hypotheses have been offered to explain discrepancies found between professed and attributed beliefs, oftentimes pointing to presumed features of teachers' cognition (e.g., beliefs residing in separate areas of cognition, not being well integrated with one another). The present findings cast some doubt on extent to which we can be certain of these explanations. That's not to say that these theories about cognition are incorrect, it is just less clear that previous findings really provide as substantial support for those claims as might be presumed. The current findings do suggest that beliefs might not be as compartmentalized in cognition as previously hypothesized. While the present findings do not falsify theories of how beliefs function in teachers' cognition, additional studies are called for which make use of more robust data that are less susceptible to the various weaknesses identified here so theories can be refined.

Now I turn to the claim that studies of the role of beliefs in shaping teaching practices should rely on beliefs data obtained in conjunction with data on the practices that one seeks to understand. This stands in contrast to studies where beliefs and teaching practices are categorized separately and then compared. In the data samples presented earlier, findings link particular beliefs to quite specific instructional practices. Karl's beliefs about teaching (that he should instill "independence" in his students by modeling the use of very general guiding questions) provide an explanation for the kind of problem-solving support he provided to his students. A similar connection can be seen between Zachary's beliefs (his role as "guide") and how he interacted with his students (by directed them to aspects of problems they should consider further). This is not the level of detail found in most studies of beliefs and practices.

The present findings do not demonstrate that teachers' beliefs cannot be productively represented by classification and categorization schemes

of the sort commonly used. What is suggested, however, is that the use of such categorization schemes might be unduly or unintentionally influencing the findings. If methods can only capture beliefs that fit into particular categories, researchers might be unintentionally blinding themselves to other possibilities. Put another way, one can only "see" what methods are designed to capture. It might also be that connections of beliefs to practices can only be seen at very fine-grained or detailed levels of investigation. In addition, it could be that such connections are highly dependent on the context or situation – visible in one situation but not in another. All of these issues merit further investigation.

The current findings have some potential implications for research on teacher preparation and change. Research on these programs often documents very little success in supporting teachers to alter their beliefs (and practices). It is possible that researchers have just been unable to gain the necessary kind of access to the beliefs that teachers possess. For example, it is possible that researchers have accessed beliefs in ways that do not actually capture what teachers believe and then are attempting to help teachers modify those beliefs (which are not the ones they really hold) and measuring changes in the beliefs that were never really the relevant ones. If more is known about beliefs shaping particular practices, maybe professional development programs could be designed to target those beliefs and then if those beliefs were assessed them afterwards maybe change would actually be evident. It could be that programs that target teachers' beliefs are not focused on the beliefs that are most relevant to the practices that the programs are trying to promote. For example, although the study reported here was not about teacher change, without videoclip interview data, someone might have designed professional development for Karl and Zachary that endeavored to shape their beliefs (as captured by general characterizations) in ways that were counter-productive to achieving the kinds of instructional practices that were desired. In the case of Zachary, his belief in teachers as "guides" might have seemed likely to lead to very directive instruction. Without the more specific data on his beliefs, connected to particular practices, the design of this (hypothetical) professional development might have been very ineffective.

The final of the main claims is that, no matter how data are collected and analyzed, all beliefs are attributed to teachers by researchers. To claim that beliefs are professed and are in some sense "pure" representations of teachers' cognition ignores the roles that methods play in research and roles that researchers play in reporting data. Various choices were made in gathering and reporting belief data for Karl and Zachary. The hope is, however, that videoclip methods allow shared understanding to be assessed and generated and that the close

connections to examples of practice make accurate attributions of beliefs more likely.

Whether researchers use videoclip interviews or other methods for obtaining data on teacher's beliefs, it seems important for researchers to place an emphasis on developing and using methods that enable the most accurate attribution of beliefs possible instead of focusing extensively on distinctions between professed and attributed beliefs. By focusing on the explanations teachers generate for instructional decisions, tied to specific examples of actual interaction with students, it may be possible to refine existing theories of connections between beliefs and practices or come to understand the phenomena in ways that enable the field to strengthen other approaches to illuminating factors that shape teaching practices.

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NATASHA M. SPEER  
*Michigan State University*  
*333 Erickson Hall, East Lansing*  
*Michigan 48824, U.S.A.*  
*E-mail: nmspeer@msu.edu*