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Situating epistemological development

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Abstract: Personal epistemology as a field has been around for forty years and generated a wide assortment of models to explain epistemological development. Dominant frameworks are inspired either by Piagetian or information processing perspectives on cognition, and all have failed to explain a range of empirical results that question the stability and coherence predicted by these frameworks. Recent models from a more situated perspective seem much more capable of explaining the variability seen empirically. This paper adds to this situated perspective by outlining a research approach for "locating" epistemic beliefs within analyses that triangulate between people's participation in knowledge construction and evaluation, the artifacts such participation may produce, and individual's reflection upon both participation and artifacts. Examples of such work are used to demonstrate the fruitfulness of this approach.

Epistemic cognition and epistemic belief

What do people think knowledge is, or how we get it, or why we believe it, or what it means to know something? How do such ideas develop throughout people's lives? How is that development shaped by the experiences people have, in school, on the playground, in their homes, at their jobs, or anywhere else? How do these ideas influence how people think about their world, make judgments, solve problems, or learn new things? These questions are at the heart of the study of personal epistemology, people's beliefs about knowledge and knowing. The field of personal epistemology has been going strong for forty years now, generating a variety of models to account for the development of epistemological beliefs. This growth has occurred alongside, and perhaps even prompted, a concurrent growth in the educational concern that learning in the disciplines should include understanding of disciplinary epistemologies. Yet, none of the theoretical models put forth in the last forty years adequately explains the array of empirical findings within personal epistemology or related studies of epistemic cognition.

Also over the last forty years, there has been a cultural turn in psychology, inspired by the theories developed by Vygotsky (1978) and his contemporaries, and further developed by many others (Cole, 1996; Engeström, 1987; Lave & Wenger, 1991; Rogoff, 1990; Wenger, 1998; Wertsch, 1985). This cultural turn is largely absent in personal epistemology research. Indeed, it can be hard to discern in cognitive developmental research generally. Two features of sociocultural perspectives have particular importance to studies of epistemic cognition. One is the conceptualization of cognition as situated within activity, and the second is that all such activity is inherently cultural (and historical). The ways in which epistemic cognition may be situated has only recently begun to be theorized (Chinn, Buckland, & Samarapungavan, 2011; Hammer & Elby, 2002). My aim here is to build on these recent efforts in two ways. The first is to emphasize the ways in which epistemic cognition is culturally situated. That is, in order to properly understand the epistemic beliefs that individuals may develop it is necessary to understand how such beliefs derive from cultural activity, both everyday activity and activity situated within disciplinary cultures (e.g., of science). A second aim is to propose a particular approach to conducting situated research on epistemic cognition that can productively coordinate the range of research methods required to understand the complex terrain that is epistemic cognition.

The argument proceeds in two parts. First, the major theoretical perspectives that have been proposed within the field of personal epistemology since Perry's (1970) seminal work are summarized. One might think such a summary hardly necessary given the quantity of recent reviews of personal epistemology research (Hofer & Bendixen, in press; Hofer & Pintrich, 2002; Khine, 2008; Muis, Bendixen, & Haerle, 2006). Such reviews are typically neutral in their evaluations of competing theories, however, whereas a critical examination emphasizes how existing models fail to explain available data. The second part of the argument then describes a situative perspective on epistemic cognition, what it looks like, what it can explain, and how it can be developed.

Before getting into the main line of argument, it may be useful to clarify some terminology. The study of people's ideas about knowledge and knowing, and how these develop, has occurred primarily in two distinct strands of research. One of these is developmental research on the young child's theory of mind and the emergence of "folk epistemology" (Astington, Pelletier, & Homer, 2002; Montgomery, 1992). A related line of developmental research is that concerned with causal inference and causal reasoning (Moshman, 2004). This developmental work, targeted primarily but not exclusively at younger children, tends to examine particular forms of cognition: causal inference, reasoning about false belief, and so on. In contrast, personal epistemology research has largely focused on adolescents and adults and framed its focus primarily around the construct of "epistemological belief" (Hofer & Bendixen, in press; Hofer & Pintrich, 1997).

R. Kitchener (2002) usefully joins the developmental and personal epistemology strands of research together around a mutual concern for what he favors as "folk" epistemology, meaning the commonsense ideas

that people develop about knowledge and knowing. Kitchener maintains that psychologists studying folk epistemology tend to introduce confusion between the epistemic and the epistemological. From a philosophical perspective, any particular epistemology, i.e., theory of knowledge, is comprised of epistemic beliefs – beliefs about the nature of knowledge and knowing. Epistemological beliefs, from this perspective, would be beliefs about epistemology, i.e., a meta-epistemology. This distinction has unevenly penetrated into personal epistemology research, with some researchers adhering to Kitchener's distinction and others not. Here, I will try to abide by it, qualifying cognitive elements like belief as epistemic to connote that they refer to individual's ideas about knowledge and knowing, not about epistemology per se.

Some personal epistemology scholars have begun to shy away from talk of beliefs, for reasons discussed below, and instead talk of epistemic cognition (Chinn, et al., 2011; Greene, Torney-Purta, & Azevedo, 2010). The focus on epistemic cognition rather than epistemic belief signals a focus on process over cognitive structure, on the kinds of reasoning people may be doing rather than the set of beliefs that may drive that reasoning. Of course, the relation between cognitive structures and the reasoning they enable is precisely the focus of developmental research, and much of what we have learned about epistemic cognition and/or belief has come from efforts to understand how cognitive structures enable forms of reasoning. Yet, from a sociocultural perspective on development, the typical cognitive view that knowledge structures in the head are retrieved and applied as needed fails to account for the ways in which cognition is influenced by the material and social aspects inherent to human activity (Packer, 2001). Development from this perspective involves qualitative changes in cognition mediated by cultural activity and the tools involved in such activity.

The argument I make here is that personal epistemology researchers have largely ignored the culturally situated nature of knowledge and knowing, and thus the situated character of epistemic cognition and epistemological development. This is particularly apparent in how issues of "domain-specificity" are treated, which is almost entirely without reference to the practices of knowledge construction and evaluation of specific domains, such as history, math, or science. More fundamentally, the survey research favored by personal epistemology researchers suffers from two basic problems. One is that taking a survey, or any other form of belief measurement, is itself a particular, and peculiar, social interaction fraught with troubles of misperception (Suchman & Jordan, 1990). The second is that such measurement efforts are far removed from people's actual efforts to construct or evaluate knowledge, and unable to explain how material and social resources are recruited into those efforts. That is, they are inherently limited in their capacity to trace epistemological development.

Models of epistemological development

Perry's (1970) groundbreaking study of (male) Harvard students' trajectories of intellectual development during the college years created the field of personal epistemology. As Hofer and Bendixen (in press) discuss, it has been widely taken up by researchers in higher education interested in student development. Perry's model of epistemological development was heavily influenced by Piaget, and subsequent models have arisen both in response to Perry's work and in relation to the changing status of Piaget's theory and more recent information processing theories of cognitive development. I discern four kinds of models populating the personal epistemology landscape: classic Piagetian stage theories, neo-Piagetian developmental theories, belief systems models, and recent situative models.

Classical developmental stage theories

What I mean by a "classic" stage theory is one with three characteristics, derived from Piaget's theory of cognitive development. First, such theories posit an invariant sequence of stages of development, each one qualitatively different from the others. Stage theories propose that all individuals proceed through the same sequence of stages, though not necessarily at the same rate. Most importantly, in classical stage theories stages cannot be skipped. Second, each stage is presumed to entail broad qualitative changes in cognitive function, quite general in their scope. Movement to a new stage is presumed to lead to fundamental changes in cognitive structure and hence how one reasons across domains. Third, classic stage theories all have an endpoint, a final stage that reflects the *telos* of development. This final stage reflects the ultimate reach of human development.

Within personal epistemology research, there are two classic stage theories. The first is Perry's model of epistemological development, and the second is the reflective judgment model developed by King and Kitchener (1994, 2004). Both theories propose seven stages of epistemological development, advancing in roughly the same way through three major phases. The first is an absolutist perspective in which knowledge is seen as objectively in the world, knowable with certainty, and derived from authoritative sources. The second phase is an unmoored relativism in which knowledge is uncertain, authoritative sources are untrustworthy, and all are free to believe what they wish. The resolution to this relativism is an evaluative stance that concedes that knowledge is constructed, and not knowable with absolute certainty, but asserts that knowledge claims can be evaluated according to standards of reason and evidence. That is, it is possible to say that some knowledge is more justifiable than others. These two theories differ in important respects. Notably, we owe the original conception of epistemic cognition to Kitchener (1983) and her argument that epistemic cognition is a kind of

processing reserved for ill-structured problem solving where gauging one's progress requires some idea of the form of an answer and appropriate processes for generating such an answer. In this sense, King and Kitchener's theory is much more clearly and cleanly epistemic than Perry's.

There are a number of problems with these theories. One is that the stages at the lower and upper ends of the continuum are hypothesized but rarely, if ever, seen empirically. Perry and King and Kitchener propose that epistemological development may not even start until adolescence, making it quite difficult to reconcile their accounts with related developmental research in theory of mind and causal inference, both of which are inherently epistemic domains. While Piaget's theory has obviously been enormously influential, and beneficial, for the study of human development, central aspects of the original theory have not fared well within developmental psychology. Specifically, the basic notion of stages was largely abandoned by developmentalists decades ago, with Susan Carey (1986) going so far as to call Piaget's stage theory "fundamentally misleading." Theoretically, then, it seems unlikely that epistemic cognition would be the only area of cognitive development that proceeds in a stage-like manner. Empirically, these stage theories simply fail to explain available data. Research in science education on students' ideas about the epistemology of science reveals largely that these ideas are inconsistent and unstable (Sandoval, 2005), in contradiction to stage theory predictions. King and Kitchener themselves found in their own studies that subjects can rarely be placed at a single stage (King & Kitchener, 2004). Stage theories predict a global coherence to epistemic beliefs and epistemic cognition that is simply not found in empirical studies.

Neo-Piagetian developmental theories

The neo-Piagetian perspective characterizes development as a trajectory of increasing capacity or sophistication, but one that relies not on changes in underlying cognitive structure in the sense meant by Piaget, but on changes in knowledge. Contrary to Piaget, contemporary developmental psychologists argue that children in fact do think like adults, they simply have less experience and knowledge to bring to bear. Thus, changes in how children think are the result of changes in what they know and how they organize that knowledge, rather than changes in basic cognitive structures or mechanisms.

Several personal epistemology models fit this approach, abandoning strong stances on general stage-like changes in favor of developmental trajectories (Baxter Magolda, 1992; Belenky, Clinchy, Goldberger, & Tarule, 1986; Hallett, Chandler, & Krettenauer, 2002; Hofer, 2000; Kuhn, Cheney, & Weinstock, 2000). These models differ in their generality, with some reflecting domain-specific aspects of models of expertise developed in cognitive science. These models share the progressive *telos* of the classic stage theories above, and the progression from absolutism through relativism to evaluativism. Both Kuhn and Hofer advance different theories about domain-specificity, but agree that within a domain epistemic development advances in the same general direction. A big improvement of these models over the classic stage theories is they directly concern themselves with young children and the lifespan of development. Yet, these neo-Piagetian theories suffer from the same inability to explain empirical discrepancies. Specifically, these theories predict that within a single domain, people can be attributed to a single, coherent epistemological stance (i.e., an absolutist), but this does not seem to be the case (Bromme, Kienhues, & Stahl, 2008; Rosenberg, Hammer, & Phelan, 2006; Sandoval, 2005). Chandler has argued that the developmental trajectory may be recursive, that children may cycle through these levels twice (Chandler, Hallett, & Sokol, 2002), but evidence for this claim seems lacking.

The abundant evidence of a general developmental trend from absolutism toward evaluativism has been characterized as an effort to coordinate objective and subjective components of knowing (Kuhn, 2001). The discrepant evidence of clear developmental trajectories within or across specific domains presents a dilemma, and the apparent developmental trend from absolutist to relativist/multiplist, to evaluativist may be an artifact of the instruments researchers use to assess epistemological stances, as has been the case in studies of epistemological views of science (Lederman, Wade, & Bell, 1998). A situated approach to the study of epistemic cognition provides a more grounded way to explicate possible developmental trajectories and link such development to particular kinds of experiences.

Belief Systems Models

In contrast to frameworks proposing developmental trajectories, there are now several personal epistemology models that can be characterized as "belief systems" models. These frameworks are heavily influenced by information processing views on cognition, specifying a variety of inputs into the system, modules of the system and their interactions, and proposed outputs from the system. Interestingly, the belief systems models in personal epistemology rely almost exclusively on survey instruments to measure proposed components of the epistemological belief system. These models share an emphasis on two major components of epistemology (Hofer & Pintrich, 1997): the nature of knowledge and the nature of knowing. The knowledge component is conceptualized in terms of two dimensions, the certainty of knowledge and the complexity of knowledge. The knowing component is also defined in two dimensions: the source of knowledge and the means of justification.

This multi-dimensional systems approach was initiated by Schommer (Schommer, 1990; Schommer-Aikins, 2004), who posited five (later four) separate dimensions that, she argued, can develop independently. Schommer's approach to detecting and measuring these dimensions involved the development of a survey, the Epistemological Beliefs Questionnaire, that has been widely used throughout the world. Schommer's instrument and its many variants, however, consistently fail to produce the dimensions this model predicts (Clarebout, Elen, Luyten, & Bamps, 2001; DeBacker, Crowson, Beesley, Thoma, & Hestevold, 2008; Qian & Alvermann, 1995). These and many other studies (including Schommer's own as discussed by both Clarebout et al. and DeBacker et al.) cast a great deal of doubt on this dimensional model as an adequate explanation of epistemic beliefs and their development. It is surprising, in fact, that this survey remains popular given its well-documented problems.

One response to these issues has been to propose systems models that attempt to account more explicitly for a multitude of other factors that might influence epistemic cognition. Schommer, now Schommer-Aikins, proposed expanding her model such that explicitly epistemic beliefs are just one component in a complex network of belief systems that might influence learning (Schommer-Aikins, 2004). Bendixen and her colleagues have proposed a variety of process models to attempt to characterize epistemic belief change and development (Bendixen & Rule, 2004; Muis, et al., 2006). So far, the complexity of these models appears to have resisted empirical test, nor have these models been applied to the explanation of extant data. Moreover, it is far from clear that the survey methods favored by researchers in this school are capable of explicating processes of change. Altogether, then, the prospects of systems models to explain epistemological development are cloudy, at best.

Taken altogether, the variety of theoretical models proposed to explain epistemological development generally fail to explain the full range of relevant data, either generated within personal epistemology studies or related findings from science education or other disciplines. They all struggle to explain the widely documented variability of epistemic cognition within and across domains (Rosenberg, et al., 2006).

Locating epistemic belief within situated activity

A situative perspective on cognition (Greeno & The Middle School Mathematics Through Application Project Group, 1998; Lave & Wenger, 1991) provides a way to explain available data on epistemological development and account for conflicting evidence on the stability and coherence of epistemic cognition. This perspective explains cognition as tightly bound to social and material aspects of particular situations, thus variability across situations, rather than across broad domains, would be expected. The situated view argues not only that individual thinking and reasoning depend upon and are inherently mediated by social and material resources, but that these resources are themselves historical, cultural artifacts. On this view, epistemic beliefs emerge from and are linked to particular forms of activity.

It may also be the case that such beliefs are not really beliefs in the sense that they are stable cognitive entities. Instead, what people express as beliefs about epistemic matters may be ad-hoc constructions built from networks of finer-grained, i.e., more situated, cognitive resources (Redish & Smith, 2008). The most important consequence of this characterization is that it is unlikely that potential epistemic beliefs can be straightforwardly "read" from people's responses to particular questions or performances on particular tasks. Rather, what such performances provide is a glimpse on some candidate resources that people bring to bear in the particular situation. This implies that research intended to characterize epistemic cognition must fundamentally be involved in triangulation across a variety of situations and performances, and should be skeptical that a person's response to a single task – a survey, an interview, or some problem – directly indicates a stable belief.

Consequently, efforts to understand epistemic cognition and its development should be grounded in studies of how people go about constructing knowledge for themselves, and their efforts to evaluate knowledge claims made by others (including textbooks, newspapers, TV talking heads, teachers, their parents, or anyone else). Building knowledge for oneself and evaluating knowledge claims from the world both entail engaging in particular cultural practices tied to particular situations (at particular points of time). How people participate in these practices, and how they may think about their participation and its purposes, provides a window into the potential epistemic beliefs they bring to bear on particular kinds of situations. Consequently, epistemic beliefs can be located, so to speak, by triangulating among three facets of such participation, as shown in Figure 1.

One important way to understand the epistemic ideas that people bring to bear is to examine their participation in practices of knowledge evaluation and construction. Changes in the form of participation are indicators of changes in the meaning that individuals make of the activity in which they are engaged. For example, changes in children's forms of participation in mathematical activity indicate changes in their ideas about what is mathematics (Cobb, Stephan, McClain, & Gravemeijer, 2001). Children's changing arguments about science topics over time suggests the internalization of certain norms for argumentation, and thus changed ideas about what it means to have a good scientific explanation for something (Rosebery, Warren, & Conant, 1992; Warren & Rosebery, 1996). *Change* in participation can indicate a shift in epistemic perspective, but it is the shift itself that suggests what particular epistemic ideas are brought to bear in the first place.

Studies of participation raise the issue of the unit of analysis, the unit to which epistemologies may be attributed. Rosenberg et al. (2006), for example, present a compelling case study demonstrating how a group of students shift their epistemic stance over the course of a single 15 minute episode. Their analysis highlights how changes in the framing of an activity shift participation, and the consequent epistemic resources that may be deployed in the situation. Their analysis draws on the epistemological resources theory's attempts to articulate epistemic modes, or frames – constructs that attempt to characterize the interactional contexts in which a person may or may not deploy particular epistemic resources (Hammer, Elby, Scherr, & Redish, 2005). It should be stressed, though, that this is an analysis of social epistemology (Fuller, 1988) – the epistemology of the group-in-activity. Individuals within the activity can be seen to contribute potential resources to the activity, but their uptake is a group effect. Attributing particular epistemic beliefs or orientations to *individuals* during single episodes of activity is fraught, as demonstrated by the conflicting interpretations of the same episode by (Hammer, Russ, Mikeska, & Scherr, 2008) and (Sandoval, 2008). Assessing the stability or coherence of epistemic cognition of individuals seems to require analyses of their participation across a range of similar and varied contexts over time.

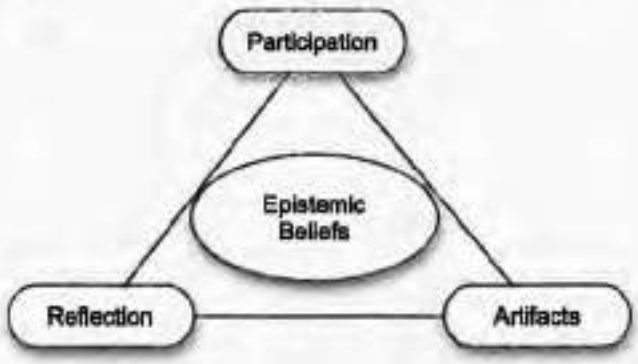

Figure 1. Facets of epistemic activity within which epistemic beliefs can be located.

Participation in knowledge construction and evaluation often produce artifacts that reflect epistemic commitments of the practice and participants. In particular, variations in the form of similar kinds of artifacts can indicate differences in the epistemic criteria used to create them. Within science education, for example, there has been a focus over the last decade on student construction of models and arguments. Looking at the models and arguments that children make can tell us something about what they think makes a good model or a good argument. Analyses of secondary students' written explanations, for example, suggest that explicit justification to link evidence to claims is not commonly recognized as an epistemic criterion for scientific explanations (McNeill, Lizotte, Krajcik, & Marx, 2006; Sandoval & Millwood, 2005).

Studies of participation and artifacts can each shed some light on the epistemic beliefs people apply to efforts to make knowledge. Yet, people's participation in constructing knowledge artifacts is highly telegraphic. A crucial way that Chinn et al. (2011) have expanded the conceptualization of epistemic cognition is to include notions of epistemic aims and values. Epistemic aims are the goals people pursue through knowledge practices within a particular context, and epistemic values refer to the value that achieving such aims has for people. Analyses of participation or artifacts are insufficient to uncover the epistemic aims people may pursue. A student may fail to justify how some piece of data supports a claim because they do not know it is an important aspect of satisfying the epistemic aim of building a justified explanation, or they may hold a different epistemic aim. Chinn and colleagues also discuss epistemic virtues, which they describe as stable dispositions toward knowledge (e.g., skepticism or open-mindedness). These too are unlikely to be uncovered simply by looking at how people participate in knowledge construction or evaluation.

Consequently, it is necessary to devise ways to have people reflect on their practices of knowledge construction and evaluation in order to produce a more complete account of epistemic belief. Such reflection is itself a particular cultural activity, of course, and has to be interpreted as such; i.e., it is a particular form of participation. Reflection here refers to reflection on one's participation and the artifacts produced by it. It seems critical that any attempt to ask people what they think about knowledge and knowing has to be grounded in situations close to their own experience.

As an example, Metz (2004, 2011) has engaged quite young children, 5-7 years old, in sustained sequences of guided scientific inquiry, such that children take on increasing responsibilities for various roles and ultimately design and conduct their own investigation into some phenomenon (e.g., cricket behavior). They represent their work in research posters that then become the props for reflective interviews that focus primarily

on the children's judgments of the certainty of their results and conclusions. Metz has shown that these children are quite sensitive to sources of potential error in their own work, and consequently regard their conclusions as tentative. It may be the case that these children also believe they could achieve certainty if they corrected these errors, Metz' methods do not address this directly, but it remains that these very young children are sensitive to the idea that the epistemic status of particular claims is tied to the means of generating the claim. Clearly, to characterize these children's ideas about knowledge to be either "certain" or "simple," as most instruments of personal epistemology would do, or to characterize them as "absolutists," misses the point. Such characterizations are gross simplifications of the epistemic resources children bring to bear in this situation, and provide little explanatory power to account for children's reasoning.

For another example, Sandoval and Çam (2011) asked 8 and 9 year olds to choose which story character had the "best reason" for deciding whether or not to believe a causal claim. When given the choice between data, even inconclusive data, and an authority figure, children were overwhelmingly more likely to choose the character that had data as having the better reason. At the same time, their reason was commonly based on the credibility that data gave to the story character. This suggests that children ascribe epistemic authority at least partially on the basis of evidence and not simply to an actor's status as an authority. These studies and others (Lehrer, Schauble, & Lucas, 2008; Rosenberg, et al., 2006; Ryu & Sandoval, in press) suggest children have developed a variety of productive epistemic resources even by the time they start school that can be triggered and deployed appropriately in contexts framed to make their use meaningful for achieving epistemic aims.

Conclusions

Theories, and consequent research, in personal epistemology must adopt a more situated perspective on epistemic cognition to productively confront and explain empirical findings from a variety of fronts. Piagetian and neo-Piagetian developmental theories predict consistency and coherence that is not seen in empirical studies. Belief systems models inspired by cognitive information processing perspectives fail their own efforts at empirical validation, or appear too unwieldy to enable empirical work. The epistemological resources framework of Hammer and Elby provides one starting point for a situated theory of epistemological development, and the recent re-conceptualization of epistemic cognition offered by Chinn and colleagues expands the purview of personal epistemology by fruitfully including epistemic aims as part of the context of epistemic cognition. The contribution offered here is a methodological approach for locating epistemic beliefs, conceived as the cognitive consequences of epistemic cognition, within situated activity by triangulating between multiple forms of analysis. I have presented some examples of such work, even if the researchers doing it may not identify themselves as personal epistemology researchers.

At heart, the argument here is a plea for researchers of epistemological development to seriously attend to the demands of understanding how people actually go about trying to produce knowledge for themselves, and to adopt methods that can meet those demands. From the situated perspective outlined here, surveys or interviews of epistemological belief must be seen as particular, and highly unusual, cultural activities where the potential for participants to talk past each other is quite high. They hide the richness and nuance of the epistemic resources children can muster, and which provide starting points for instruction and development.

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