

Personal Epistemology and the Constructivist Metaphor: An Alternative

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Abstract

In the past 35 years, considerable effort has gone into the study of personal epistemology. The results of these studies are often interpreted through a constructivist metaphor, in which the human mind is viewed as having a logical structure similar to that of Euclidean geometry. Yet memory research as well as studies of pre-literate cultures provide reason to doubt the constructivist metaphor. As an alternative, I will argue that that personal epistemology is better viewed as a performance tendency, similar to slicing off the tee in golf.

The standard model

The seminal study in “personal epistemology” is William G. Perry’s *Forms of Intellectual and Ethical Development in the College Years (1970)*, conducted at Harvard University in the 1950s and 1960s. Through interviews with male undergraduates, Perry identified nine epistemological “positions.” In positions 1, 2, and 3, the student takes a highly polarized (right vs. wrong) and highly authoritarian view of knowledge. In position 1, “Right Answers for everything exist in the Absolute, known to Authority, whose role is to mediate (teach) them” (p. 9). In position 2, the student recognizes uncertainty, but explains it as incompetence on the part of specific Authorities, thereby preserving the perception that every question has a single correct answer. In position 3, the student explains uncertainty as temporary lack of knowledge on the part of otherwise competent Authorities, confident that eventually, the Authorities will find the right answer. Positions 4 and 5 are relativistic epistemologies. In position 4, the student asserts that outside the realm of Authority, “everyone has a right to his own opinion,” while in position 5 the student extends a relativistic, context-specific standpoint to all knowledge and values, including those of the authorities (now lower-case). In positions 6 through 9, the student recognizes that although knowledge and values are context-dependent, intellectual commitment to particular values or knowledge is necessary. In position 6, the student recognizes the need for commitment in a relativistic world. In positions 7 and 8, the student begins to make intellectual commitments and explores their implications. In position 9,

the student recognizes that commitment is an “ongoing, unfolding activity through which he expresses his life style” (p. 10).

Perry’s taxonomy of personal epistemologies can be summarized as a progression from a dualistic authoritarian/absolutist view of knowledge (there exists an objective correct vs. incorrect and right vs. wrong) to a relativistic view of knowledge (all opinions are equal) to a post-relativistic standpoint (some positions are more defensible than others). Perry explicitly describes this as a matter of development or growth. Younger students are more likely to hold an authoritarian/absolutist view of knowledge, while older students are more likely to hold a post-relativistic view of knowledge.

Numerous personal epistemologies have followed. For *Women’s Ways of Knowing*, Belenky, Clinchy, Goldberger, and Tarule (1997) interviewed women from a wide variety of socioeconomic conditions and educational levels. They identified seven epistemological levels in adult women: 1) silence (lacking voice and opinion), 2) received knowledge (relying on external authority), 3) subjective knowledge: the inner voice (locating authority internally), 4) subjective knowledge: the quest for self (locating authority internally, but in dialogue with external influences), 5) procedural knowledge: the voice of reason (relying on procedure to arbitrate truth), 6) procedural knowledge: separate and connected knowing (pursuing conflict or cooperation between ideas), and 7) constructed knowledge (developing ideas in cooperative dialogue). Although Belenky et. al. did not claim that these seven levels are “stages” in the sense that one must progress through the lower levels in order to reach the upper levels, they associate the upper levels with greater intellectual and emotional maturity and higher levels of academic achievement. Generally speaking, women in the lower levels tend to believe that there are absolute truths and falsehoods, and they attempt to separate truth from falsity through external

authority (level 2) or internal authority (levels 3 and 4). Women in the upper levels are less likely to believe in absolute truths, and they are more likely to resolve intellectual conflict through negotiation and/or cooperation.

For *The Skills of Argument*, Kuhn (1991) interviewed adults from a variety of socioeconomic and educational backgrounds, centering each interview around one of three questions: what causes prisoners to return to crime after they're released, what causes children to fail in school, and what causes unemployment? Based on these interviews, Kuhn identified three levels of personal epistemology: absolutist theories (experts can know the causes with certainty, so these participants tend to express certainty in their answers), multiplist theories (experts can not have certain knowledge, also leading these respondents to express expert-like certainty in their own answers), and evaluative theories (experts can not have certain knowledge, leading these participants to express *uncertainty* in their answers). Kuhn found that younger people were more likely to be absolutists than older people and that people without a college education were more likely to be absolutist than college-educated participants.

For *Developing Reflective Judgment*, King and Kitchener (1994) interviewed people (mostly students) ranging from 14 to 62 years of age. In each interview, the respondents were asked to consider an "ill-structured problem," i. e. a problem for which there is no single clear-cut solution. An example is:

Some people believe that news stories represent unbiased, objective reporting of news events. Others say that there is no such thing as unbiased, objective reporting, and that even in reporting the facts, the news reporters project their own interpretations into what they write (260-261).

Based on these interviews, King and Kitchener posit seven stages of reflective thinking, beginning with three pre-reflective stages in which knowledge is seen as absolute and can be known by direct observation or authority, progressing through two quasi-reflective stages in

which knowledge is uncertain and personally idiosyncratic or relative, and concluding with two reflective stages, in which knowledge is a process mediated by evidence.

For *Making Their Own Way: Narratives for Transforming Higher Education to Promote Self-Development*, Baxter Magolda (2001) began by interviewing college students and then followed up with periodic post-college interviews in a longitudinal study. Baxter Magolda posits four phases in the “journey toward self-authorship”: “following formulas,” in which life plans are adopted from authorities; “crossroads,” in which authorities are questioned, “becoming the author of one’s life,” in which beliefs are chosen, and “internal foundation,” in which a mature internal belief system is developed.

All five of these personal epistemology studies are based on interviews, but their interview protocols and participant populations are very different. Yet the resulting epistemological taxonomies are strikingly similar. In every case, the youngest and/or least educated participants tend to express the view that knowledge is certain. Every question has a single correct answer, and experts know or can know that correct answer. Consequently, these participants take a highly authoritarian view of knowledge. In all five studies, this view of knowledge as certain and authoritative is succeeded by some sort of naïve, subjective relativism (all opinions are equal), followed by a mature relativism (certain knowledge does not exist, but some opinions carry more weight than others). The absolutist/authoritarian view is regarded as an unsophisticated epistemology, while mature relativism is regarded as a sophisticated epistemology. Together, these five taxonomies constitute something of a “standard model,” i. e. a consensus in personal epistemology.

Challenging the Standard Model

Beginning in the late 1980s, Marlene Schommer (1990) began to challenge the “standard model.” Specifically, Schommer questioned the idea that at any given moment, a person’s epistemological beliefs can be characterized by a unidimensional “position” (Perry), “way of knowing” (Belenky *et. al.*), “theory” (Kuhn), “stage” (King and Kitchener), or “phase” (Baxter Magolda). Schommer developed a Likert-style questionnaire consisting of 63 statements, in which possible responses for each item ranged from 1 (strongly agree) to 5 (strongly disagree). After administering this questionnaire to 286 college students, Schommer identified five “more or less independent” (p. 503) dimensions:

1. Knowledge is simple rather than complex.
Sample items: “Most words have one clear meaning.”
“When I study I look for specific facts.”
2. Knowledge is handed down by authority rather than derived from reason.
Sample items: “I don’t like movies that don’t have an ending.”
“Scientists can ultimately get to the truth.”
3. Knowledge is certain rather than tentative.
Sample items: “People who challenge authority are over-confident.”
“How much a person gets out of school depends on the quality of the teacher.”
4. The ability to learn is innate rather than acquired.
Sample items: “Self help books are not much help.”
“The really smart students don’t have to work hard to do well in school.”
“An expert is someone who has a special gift in some area.”
5. Learning is quick or not at all.
Sample items: “Successful students learn things quickly.”
“Almost all the information you can learn from a textbook you will get during the first reading.”
“If a person tries too hard to understand a problem, they will most likely just end up being confused.”

Items 2 and 3 of this framework are consistent with the standard model, except that Schommer found that certainty and authority are independent dimensions. In other words, a person’s belief

in certainty of knowledge is unaffected by their belief in authority. Item 1 represents a minor departure from the “standard model.” Items 4 and 5 represent a substantial departure from the “standard model,” adding beliefs about learning to a general epistemological framework. Schommer claimed not only that these five beliefs are independent, but that they are “generalizable across [at least] two content domains” (p. 503).

Schraw, Bendixen, and Dunkle (2002) eventually challenged Schommer’s epistemological questionnaire and developed the 28-item Epistemological Belief Inventory (EBI) as an alternative. Schraw *et. al.* claim that Schommer’s questionnaire does not support her five-dimensional epistemological framework. But in an interesting turnabout, they claim that the EBI *does* support Schommer’s framework, thereby validating these five independent dimensions.

Personal Epistemologies of Physics Students

One would expect that a student’s epistemological beliefs would influence her approach to learning. For example, if a student believes that knowledge is certain and known to authority, we might expect that she will seek a single “correct” explanation from the teacher and be uninterested in alternative explanations. Furthermore, we might expect that just as her personal epistemology affects her approach to learning, so her approach to learning will affect her achievement. A variety of studies (BouJaoude, 1996; Discenna & Howse, 1998; Haidar, 1999; Songer & Linn, 1991; Yerrick, Pedersen, & Arnason, 1998) have attempted to establish such connections between epistemological belief and science learning. Rather than pursue the general efforts to connect personal epistemology to science learning, I am restricting the present study to the efforts to establish an epistemological framework among physics students.

David Hammer (1994; 1995) was among the first to explore the epistemological dimensions of learning physics. Through extensive interviews with six first-year undergraduate physics students, Hammer developed a three-dimensional epistemological framework:

1. Coherence: The structure of physics knowledge is
 - (a) a collection of isolated pieces (unsophisticated view) or
 - (b) a single coherent system (sophisticated view).
2. Concepts: The content of physics knowledge is
 - (a) mainly in the formulas (unsophisticated view) or
 - (b) mainly in the concepts that underlie the formulas (sophisticated view).
3. Independence: Learning physics mainly involves
 - (a) receiving information (unsophisticated view) or
 - (b) an active process of reconstructing one's understanding (sophisticated view).

Whereas Schommer attempted to establish independent epistemological dimensions, Hammer is at pains to point out that his three epistemological dimensions are not necessarily independent of each other.

Building on Hammer's work, Edward Redish, Jeffery Saul and Richard Steinberg (1998) developed the Maryland Physics Expectations survey (MPEX), a 34-item Likert-scale survey. Although Redish *et. al.* claim that "repeated, detailed, taped, and transcribed interviews with individual students are clearly the best way of confirming or correcting informal observations and finding out what a student really thinks," they attempted to study larger populations through "a reliable survey . . . which can be completed by a student in less than half an hour and analyzed by a computer" (pp. 213-214). By comparing over 1500 undergraduate physics student results to about 160 "expert" (mostly experienced physics instructor) results, Redish *et. al.* rated six dimensions as novice/unfavorable vs. expert/favorable. They adopted Hammer's three-dimensional framework and added:

4. Reality Link: Physics is
 - (a) unrelated to experiences outside the classroom (novice) or
 - (b) it is useful to think of physics together with experiences outside the classroom (expert).
5. Math Link: The mathematical formalism used in physics is
 - (a) just used to calculate numbers (novice) or
 - (b) used as a way of representing information about physical phenomena (expert).
6. Effort: The students expect to
 - (a) think carefully and evaluate what they are doing based on available materials and feedback (expert) or
 - (b) not to do so (novice).

A subgroup of experts was chosen to calibrate the “expert opinion.” On 87% of the items, the experts agreed with this subgroup. Following a well-established pattern in physics education research (Hake, 1998), Redish *et. al.* administered the MPEX at the beginning of an introductory physics course (pretest) and again at the end of the semester (post test). The authors expressed no surprise that before instruction, the undergraduates agreed with the expert subgroup (i. e. responses were “favorable”) about 50%-60% of the time. However, the authors were distressed to find that at the end of the semester, the overall percentage of favorable responses substantially *decreased*. The undergraduates moved slightly closer to the experts in the Concepts dimension, remained at the same level of agreement in the Independence dimension, moved farther from the experts in the Coherence, Reality Link, and Math Link dimensions, and moved much further from the experts (by about 15%) in the Effort dimension.

At about the same that Hammer and Redish *et. al.* were developing their epistemological frameworks, Ibrahim Halloun and David Hestenes (Halloun, 1996; Halloun & Hestenes, 1998) were developing the Views About Science Survey (VASS). Each of the 30 VASS items presents two opposing statements and offers seven levels of agreement/disagreement between the two statements. Like Redish *et. al.*, Halloun and Hestenes labeled the majority response of physics teachers as the “expert” view, while the opposing viewpoint was labeled a “folk” view. In the

development and analysis of this survey, Halloun and Hestenes produced the following epistemological taxonomy:

1. Structure:
 - Science is a
 - (a) coherent body of knowledge about patterns in nature (expert) or
 - (b) loose collection of directly perceived facts (folk).
2. Methodology:
 - The methods of science are
 - (a) systematic and generic (expert) or
 - (b) idiosyncratic and situation specific (folk).
 - Mathematics is
 - (a) a tool used by scientists for describing and analyzing ideas (expert) or
 - (b) a source of factual knowledge (folk).
3. Validity:
 - Scientific knowledge is
 - (a) approximate, tentative, and refutable (expert) or
 - (b) exact, absolute, and final (folk).
4. Learnability:
 - Science is learnable by
 - (a) anyone willing to make the effort (expert) or
 - (b) a few talented people (folk).
 - Achievement depends more on
 - (a) personal effort (expert) or
 - (b) the influence of the teacher or textbook (folk).
5. Reflective Thinking:
 - For meaningful understanding of science, one should concentrate more on:
 - (a) the systematic use of principles (expert) or
 - (b) the memorization of facts (folk).
 - For meaningful understanding of science, one should:
 - (a) examine situations in many ways (expert) or
 - (b) follow a single approach from an authoritative source (folk).
 - For meaningful understanding of science, one should:
 - (a) look for discrepancies in one's own knowledge (expert) or
 - (b) just accumulate new information (folk).
 - For meaningful understanding of science, one should:
 - (a) reconstruct new subject knowledge in one's own way (expert) or
 - (b) memorize it as given (folk).
6. Personal Relevance:
 - Science is
 - (a) relevant to everyone's life (expert) or
 - (b) the exclusive concern of scientists (folk).
 - Science should be studied more for
 - (a) personal benefit (expert) or
 - (b) to fulfill curriculum requirements (folk).

Halloun and Hestenes divided the student responses into “expert profiles” on the one hand and “folk profiles” on the other, adding two “transitional profiles” between the extremes. They found that students who begin a class with an “expert profile” reach a significantly higher level of conceptual understanding than their “folk profile” classmates.

The Hammer/Redish (MPEX) framework was developed independently of the Halloun/Hestenes (VASS) framework, but they bear remarkable similarities. Although the twelve statements in the VASS framework make finer distinctions than the six statements in the MPEX framework, they can be aligned as follows:

VASS’s “Structure” is equivalent to MPEX’s “Coherence.”

Taken together, VASS’s “Learnability” and “Reflective Thinking” are more detailed descriptions of MPEX’s “Independence” and “Effort.”

VASS’s “Personal Relevance” is a more detailed description of MPEX’s “Reality Link.”

Taken together, MPEX’s “Concepts” and “Math Link” are a more detailed Description of the second statement in VASS’s “Methodology.”

In this alignment, no MPEX statements are excluded from the VASS framework, and only two items from the VASS framework are excluded from the MPEX framework. These are “Methodology: the methods of science are systematic and generic or idiosyncratic and situation specific;” and “Validity: Scientific knowledge is approximate, tentative, and refutable or exact, absolute, and final.” It should also be noted that with the latter statement, VASS includes all five of Schommer’s dimensions, while MPEX includes four of Schommer’s five dimensions.

Although MPEX and VASS align closely to each other, they are far from the “standard model.” The question of knowledge by authority vs. knowledge by personal construction is addressed extensively in both MPEX and VASS. However, certainty of knowledge is addressed

only in VASS, and the majority of the standard model (relativism and postrelativism) is addressed by neither VASS nor MPEX.

First Critique of the Personal Epistemology Project: Worldview

The authors of the “standard model” take a unitary worldview perspective on human thought, while Schommer and the authors of the MPEX and VASS models take a multi-dimensional worldview perspective. In either case, their work relies on the idea of worldview. Ample support for such a perspective can be found in the literature of cultural anthropology and education. For example, Nancy Allen and Frank Crawley (1998) studied the traditional band of the Kickapoo, a group of Native Americans which has resisted westernization until recently. In their study of the first generation of traditional Kickapoo to attend a U. S. school, Allen and Crawley observed:

The preference for cooperative methodology was pronounced among the Kickapoo students (100% of data) and sharply contrasted with the competitive scenario in the classroom (90% of data). Teachers were constantly baffled and frustrated by the refusal of the Indian students to compete in the classroom. Cooperation, rather than competition, is highly regarded among Kickapoo people. Most Kickapoo, for example, will not attend competitive sports games (p. 122).

This conflict in values was most apparent in situations in which teachers or administrators tried to motivate Kickapoo students. The rewards used as motivators often conflicted with traditional Kickapoo values: for example, free admission to competitive sports events, high grades, promises of material gain, and the chance to leave the area and see the world. Kickapoo culture disdains competition—in sports or grades—and values spiritualism over materialism (p. 128).

Clearly there is a divide between the Kickapoo students and their American teachers and classmates. In the face of such compelling evidence for an altogether different way of thinking, it is tempting to accept the idea of worldview at face value. This study and others like it

(Aikenhead, 1997; Kawagley, Norris-Tull, & Norris-Tull, 1998) assume “first, that worldviews ‘strive’ toward maximum logical and structural consistency; and second, that worldviews are given coherence and shape by the necessity of having to relate to an external environment” (Allen & Crawley, p. 113). Like Piaget’s idea that “cognitive disequilibrium” motivates conceptual change, the worldview model assumes that the human mind searches for philosophical consistency.

Compelling though the worldview theory might be, it is not the only way to explain the difference between the Kickapoo and American way of thinking. Worldview theorists generally adopt a constructivist metaphor for human thought. As Marcia Linn (Linn, 1987) expresses it:

There is widespread agreement that learners actively construct an individual worldview based upon personal observation and experience and that they respond to formal instruction in terms of this preexisting intuitive perspective. Research has also revealed that learners construct a sense of themselves which guides their learning behavior (Linn, p. 195).

The underlying metaphor here is that the human mind is a building which is always under construction. Learning is the process of adding new material (information) to the building, like adding a new brick on a Lego set. However, sometimes we have trouble fitting a new brick onto our building, indicating that we have made a mistake in the process of constructing our building. In science instruction, this is the typical explanation for post-instructional misconceptions--the new, correct information does not fit onto our existing Lego building: “misconceptions . . . do not arise merely from failure to absorb information but rather from erroneous interpretation based on intuitive perceptions that must be overcome” (Linn, p. 197). In order to incorporate the new information into the human mind, our Lego building must be partially dismantled and rearranged (Posner, Strike, Hewson, & Gertzog, 1982; von Glasersfeld, 1992). This is why

physics students experience such difficulty in learning Newton's Laws, and this is why the Kickapoo experience such difficulty in American schools.

If worldviews 'strive' toward maximum logical consistency, then the underlying worldview-constructivist metaphor may also be influenced by Euclidean geometry, in which five foundational postulates support a complex system of theorems, each of which stands in a strictly logical relationship to every other theorem. When a mathematician recognizes that a new piece of information (e. g. a theorem) is in logical conflict with the existing logical structure, then the new theorem will be rejected or the logical system must be modified to accommodate it, possibly at the foundational (postulate) level. This is the underlying image when Piaget describes a state of "cognitive disequilibrium," leading to the process of "accommodation." Worldview theorists assume that the human mind regulates itself, attempting to maintain a logically consistent relationship between various pieces of information.

Yet the evidence for a stable, structure-like model of human thought has its weaknesses. First of all, our memories don't seem to be particularly stable. As Elizabeth Loftus and many others have shown (Brainerd & Reyna, 1998; Hagen, 1997; Loftus, 1979; Neiser & Harsch, 1992; Payne, Elie, Blackwell, & Neuschatz, 1996; Reyna, Holliday, & Marche, 2002), memory is highly malleable and subject to change. Inaccurate memory appears to be a normal part of being human. If memory itself is so malleable, then the consistent recall of a complex, structure-like, logically consistent worldview seems highly unlikely. This is a burden that real human memory simply cannot bear. As Bible scholar John Crossan (1998) observes,

Memory is as much or more creative reconstruction as accurate recollection, and unfortunately, it is often impossible to tell where one ends and the other begins. We usually work from either or both with the same serene and implacable confidence (p. 59).

We see that memory is more of a performance than a structure. Just as no two performances are alike, so no two instances of recall are alike.

Our understanding of the verb “to remember” is subject to the metaphors of our time. Crossan argues that with the advent of widespread literacy in the industrialized world, we have come to understand memory to be stable in the way a text is stable. Yet this stable, text-like understanding of memory is not shared in oral cultures. Crossan cites the work of Milman Parry among Serbo-Croatian singers in the 1930’s. Parry recorded these illiterate singers as they performed long, epic tales. From a single artist, Parry transcribed four different versions of the same song: 154 lines, 234 lines, 279 lines, and 344 lines. Clearly these four performances are not identical, yet the singers regard them to be the same song. In an interview with a literate researcher (N), an illiterate singer (D) compares his performance of a song to another artist’s performance:

N: Was it the same song, word for word and line for line?

D: The same song, word for word and line for line. I didn’t add a single line, and I didn’t make a single mistake . . .

N: Tell me this: If two good singers listen to a third singer who is even better, and they both boast that they can learn a song if they hear it only once, do you think that there would be any difference between the two versions? . . .

D: There would . . . It couldn’t be otherwise. I told you before that two singers won’t sing the same song alike (Milman Parry, cited in Crossan, p. 75).

Here we see a conflict between two different metaphors for memory. In the oral tradition, singing the song “the same way” means that the performance has the same quality. It is equally beautiful, moving, or satisfying. In the literate tradition, singing the song “the same way” means repeating the same words, like repeated readings of the same text. It is accurate. Although the memory-as-text metaphor may be more familiar to the literate society, the memory-as-performance metaphor may be closer to the everyday experience of memory.

Given the problems encountered in comparing the mind to a logico-structural Lego set, we need a new metaphor for human thought. I believe that the Serbo-Croatian singers have it right. It's not a structure; it's a performance. We don't *have thoughts* so much as we *think*. Perhaps human thought is like swinging a golf club. Although we can identify tendencies among individual golfers (such as slicing), each performance is unique. I might have a tendency to overshoot the green, but on any given approach, I am quite capable of undershooting the green. The proclivities of the Kickapoo are not necessarily mental structures, but performance tendencies. In interviews or multiple-choice surveys, some people tend to assert that knowledge is certain and known to authority. This doesn't mean that they "have" unsophisticated epistemological structures in their brains, but rather than they tend to perform a certain way; they slice off the tee. Each performance is unique and depends on, among other things, context.

Second Critique of the Personal Epistemology Project: Context

Primarily over questions of context, David Hammer and Andrew Elby have strongly criticized the methods and conclusions of the standard model (Elby, 2003; Elby & Hammer, 2001; Hammer & Elby, 2002, 2003). Hammer and Elby describe both the standard model and the Schommer/Schraw *et. al.* model as having either a "theory-like" or a "trait-like" view of personal epistemology. The "theory-like" view is that "individuals hold epistemological beliefs in the form of declarative knowledge to which they can have conscious, articulate access" (Hammer & Elby, 2002). Their criticism of this view is that students may theorize in the context of an interview or survey, but not in the context of the physics classroom:

Students do not typically reflect directly and explicitly on the nature of knowledge and learning in their science classes, where their attention is almost always focused on concepts and phenomena. Questioning students in these ways about their epistemologies may be, to borrow an old joke, like interviewing golfers about their swings, off the course and away from their clubs: “Do you inhale or exhale when you swing the club?” It is not something they think about, ordinarily, and they may not know the answer. There would probably be a correlation between what golfers say and what they are observed to do when they play, but the former would probably not reliably indicate the latter (Hammer & Elby, 2002).

Hammer and Elby’s “theory-like” view is essentially the worldview theory described above. It’s not that we *have* a personal epistemology. Instead, we *perform* (in this case, theorize about) a personal epistemology in a specific context. In an interview, the performance might be fairly consistent from interview to interview, but in a different context, say on a particular day in a particular physics class, the performance might be very different.

Under the “trait-like” view, personal epistemology will affect an individual across context, irrespective of whether that person is aware of it, like right- or left-handedness:

Someone who is right-handed on the guitar would be very likely to be right-handed with a golf club; there is a strong basis for attributing handedness as a trait.

However, while most people can be characterized consistently as right-or-left handed across a wide range of contexts, there is not a basis for a similar claim regarding their epistemologies. There is no reason to expect that what an individual believes about knowledge in the realm of interpersonal relations, for example, about knowing and learning how to get along with others, must be consistent with what he or she believes about knowing and learning in an introductory physics course (Hammer & Elby, 2002).

While Hammer and Elby impugn the “theory-like” view on the grounds that people do not typically theorize about their daily activities, they impugn the “trait-like” view on the grounds that there is no evidence for context-independent traits. Yet personal epistemology researchers typically assume that they can locate such context-independent traits through a structured or unstructured interview or through a multiple-choice instrument.

Hammer and Elby base their critique of general epistemological questionnaires on the assumption that either “sophisticated” or “unsophisticated” epistemologies are context-independent:

[A]ccording to the consensus view as reflected in commonly-used surveys, epistemological sophistication consists of believing certain blanket generalizations about the nature of knowledge and learning, generalizations that do not attend to context. These generalizations are neither correct nor productive. For example, it would be unsophisticated for students to view as tentative the idea that the Earth is round rather than flat. By contrast, they should take a more tentative stance towards theories of mass extinction. Nonetheless, many surveys and interview protocols tally students as sophisticated not for attending to these contextual nuances, but for subscribing broadly to the view that knowledge is tentative (Elby & Hammer, 2001).

Schommer’s (1990) epistemological questionnaire includes numerous general statements which are supposed to reveal traits about the respondents, such as “A sentence has little meaning unless you know the situation in which it was spoken,” or “sometimes you just have to accept answers from a teacher even though you don’t understand them.” Yet responses to such statements are dependent on the context which the student associates with the statement. With regard to the first statement, Hammer and Elby observe: “It depends on the sentence. The meaning of ‘Andy Elby lives in Virginia’ depends on context, but much less so than the meaning of ‘Andy Elby needs help’ ” (2001). With regard to the second, they observe:

If the student’s goal is to develop an understanding, then of course she should strongly disagree. But if her goal is to get through the class, and if the tests reward rote learning, then the student should agree, even if she knows that accepting doesn’t imply understanding. In this case, the student’s agreement does not reflect epistemological naivete. Our point is that a student’s response to the item depends on the context she attaches to the question, whether it is one in which the purpose is *believing* or *understanding* (2001).

As Elby showed elsewhere (1999), a student’s goal of earning an acceptable grade is often in conflict with the goal of understanding. Given the context-sensitivity of such items, it does not

seem possible that students can be classified as having unitary “sophisticated” or “unsophisticated” epistemologies.

Hammer and Elby have shown that questionnaires are vulnerable to context. However, the standard model is based entirely on interviews, so perhaps the standard model is not vulnerable to context. Hammer and Elby show that this is not the case:

[King and Kitchener’s] reflective judgment stage 2 corresponds to an absolutist stance: Knowledge is either absolutely certain or certain but not immediately available, and it generally comes from direct experience or from authority. King and Kitchener cite the following subject as a *definitive* stage 2:

Interviewer: How do you decide?
 Subject: I decide what goes with my views.
 Interviewer: Where do your views come from?
 Subject: My teachers and how I’ve been brought up.
 As you grow up, you automatically get certain views.

It is possible that the subject is more sophisticated than she appears. King and Kitchener do not reveal the topic of discussion, but the subject may be discussing her religiously-inspired belief in creationism. Her beliefs, expressed in more academic language, could be

“When deciding what to believe about the origin of humanity, I take into account what fits with my religious views. Those views undoubtedly come from the way I was brought up, from my parents and teachers. When children are exposed to certain articles of faith over a long period, those beliefs get incorporated into the child’s views; it’s an automatic cognitive process.”

If this rewording reflects the subject’s views, then she holds some sophisticated relativist ideas about the origin of religious beliefs. Another rewording would make the subject sound firmly absolutist. We lack sufficient contextual information to characterize the epistemological sophistication of her statements in the above snippet (2004).

The respondent’s words are insufficient to judge her epistemological sophistication. We see that interviews are just as vulnerable to context as surveys. In fact, we should remember that far from insulating us from context, the interview itself is a unique context, rarely encountered by

the average person. Consequently, attitudes exhibited in an interview may bear no relationship to attitudes or behavior outside the context of the interview.

Yet for all their insight in critiquing the standard model and the Schommer alternative to the standard model, Hammer and Elby show a limited ability to apply that critique to the MPEX or VASS research. Citing Hammer's (1994) earlier work, Hammer and Elby state that "students in an introductory physics course could be characterized as having consistent epistemological beliefs *within the context of the course*" (Hammer & Elby, 2002). Referring to Elby's earlier work, Hammer and Elby note:

Epistemology researchers, including one of us, make heavy use of multiple choice and short-answer surveys, which are easily administered to large numbers of subjects. However, if contextual nuances play as large a role in epistemological reasoning as we suggest, then even the best-designed "decontextualized" surveys (such as Schommer's (1990)) face severe limitations in their ability to probe students' epistemologies. To mitigate this problem, the survey can focus explicitly on a *particular* context, for instance, by probing students' views toward knowledge and learning in their introductory physics classes. Nonetheless, the context of filling out a survey about introductory physics class differs from the context of actually learning introductory physics. Therefore, triangulating with other methods is essential (2004).

Although they separate the act of filling out a survey from the act of learning in an introductory physics course, Hammer and Elby treat the introductory physics course as a *single context*. Given the variety of activities and situations which may come up in an introductory physics course, such a standpoint is unsupportable.

On some level, Hammer and Elby seem to understand the multicontextual nature of an epistemological survey. For example, Elby (2003) insightfully criticizes the MPEX for its conflation of course-survival skills with epistemological beliefs:

For instance, MPEX tallies as “unsophisticated” a student who agrees with

“My grade in the course will be primarily determined by how familiar I am with the material. Insight or creativity will have little to do with it.”

Unfortunately, in fast-paced pre-medical physics courses that emphasize rote application of algorithms, a student may agree with this statement even though she knows that *understanding* physics involves insight and creativity.

In order to separate course-survival goals from epistemology, Elby participated in the production of the Epistemological Beliefs Assessment for Physical Science (EBAPS) (Elby, 2003; White, Elby, Frederiksen, & Schwartz, 1999), an MPEX alternative. EBAPS attempted to weed out all items aimed at course survival. For example, the MPEX item,

Knowledge in physics consists of many pieces of information, each of which applies primarily to a specific situation (Redish et al., 1998)

was replaced with the EBAPS item:

When solving problems, the key thing is knowing the methods for addressing each particular type of question. Understanding the “big ideas” might be helpful for specially-written problems, but not for most regular problems (White et al., 1999).

It seems to me that each item is equally vulnerable to the conflation of course-survival skills with epistemological beliefs. As a practical matter, energy-conservation is always true, but it is a poor problem-solving strategy for certain types of problems, such as predicting the outcome of an inelastic collision when the dissipated energy is unknown. Students may learn that relativity is always true, but in most introductory problems, relativistic effects are to be ignored. In certain situations, students learn to ignore friction or ignore gravitational effects, and their success in the course depends on their ability to recognize that different strategies are useful in different contexts. Therefore a sophisticated physics student might recognize that although the principle of conservation of energy is universal, it is not useful in solving every problem, and indeed, the

“big ideas” might be helpful only for solving certain kinds of problems. My point is that the introductory physics course is not a single context, but multiple contexts. Therefore no survey, however carefully designed, can be expected to isolate a unitary “personal epistemology in the context of an introductory physics course.”

Conclusion

The standard model, the Schommer alternative to the standard model, and the personal epistemologies aimed at physic students all rely on a “construction” metaphor. Yet as we have seen, human thought is not very much like a structure, and human thought is a great deal like a performance. Furthermore, the standard model and the Schommer alternative assume that at some elemental level, human thought is context-independent, and we have seen that this assumption is poorly supported. We have also seen that Hammer and Elby treat the introductory physics class as a single context. This assumption is also poorly supported.

Yet these epistemological taxonomies continue to be compelling for two reasons. First, despite their differences in methodology, the five “standard model” studies reach remarkably similar conclusions. This could indicate that these researchers have discovered a pattern in human development, or it could be that since they are all based on interviews, they have discovered a pattern in human interview behavior. The Schommer alternative, EBI, VASS, and MPEX studies also reached similar conclusions to each other. Again, this could be caused by a pattern in general human behavior or a pattern in survey completion. Second, the “factor analysis” used in Schommer’s epistemological questionnaire, EBI, MPEX, VASS, and EBAPS has lead to surprisingly similar taxonomies of personal epistemology. The idea that factor analysis could lead to any “independent dimensions” is particularly surprising in the face of such vague items as Schommer’s “I don’t like movies that don’t have an ending” or “people who

challenge authority are over-confident.” Yet when factor analysis reveals five independent dimensions (Schommer) or as many as twelve dimensions based on just 30 survey items (VASS), we tend to reify them uncritically. How could statistically independent dimensions be context-dependent? How could statistically independent dimensions fail to reveal something real in human nature? For me, these questions remain unanswered.

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