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Mathematicians' Religious Affiliations and Professional Practices: The Case of Bo

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Bo's case is the third of three case studies exploring relationships between the domains of religious belief and mathematical practice among university research professors. As a Buddhist, Bo's mathematics and religious views are integrated in a surprising epistemology. His epistemology and other relationships are contrasted by those presented in previous case studies of a Jewish professor and a Christian professor, at the same university. While the previous cases highlighted the transfer of methods of practice across domains and the need to reconcile potentially conflicting aspects of the two domains, Bo's case reminds educators that each student holds her own universe of thought and that mathematics plays a prominent role in developing that universe; or is it "the way of knowing *the* universe?"

This paper reports on the third of three case studies, all intended to investigate the implications of religious affiliation in the professional lives of mathematicians. These case studies offer contrasting perspectives in answer to my research question: How do strong religious convictions influence professional mathematicians' practices and their views of mathematics? The previous cases revealed the need for reconciliation of mathematical truth and professional practice with religion in order to make mathematical practice meaningful. Reconciliation can be difficult because one realm may supercede the need for the other (Norton, 2002b). However, in the case of Bo, the two realms are fundamentally integrated so that, together, they provide an epistemology.

I selected the three participants for my study because they had reputations as devout representatives of three distinct religious groups—Judaism, Christianity, and Buddhism—among professors in the mathematics department of a large southern university. Before conducting one-hour interviews with each of them I was not certain that I would be able to identify more than a superficial influence. In fact, the participants themselves were largely unaware of such a relation, but as they recounted their personal histories, evidence of significant connections emerged. For Joseph, the Jewish participant, religion helped to define and inform his professional practice of research and teaching as "meritorious activity;" on the other hand, Charles struggled through years of conflict before reconciling his early desire to do research mathematics with his most fundamental Christian beliefs. Bo's situation was different in that he developed his Buddhist beliefs and his mathematical career while simultaneously exploring other possibilities in both realms.

In my analysis of Bo's interview I identified two major themes: his belief in cause and consequence, and his world of quantifiable objects with infinite coordinates. In this paper I report on these themes along with Bo's background and relevant history, which I use to contrast Bo's unique perspective with those of past mathematicians and with the other two cases. I also include a poetic transcription in order to give a flavor for Bo's own language; though I employed artistic license in the order of phrases, the words are his (see Figure 1). A detailed account of my methods for developing both the narratives and the poetic transcription can be found in Norton (2002a).

Einstein and Bo

Because of their similarities in practice and belief, I find it especially interesting to contrast Bo's views with those of Albert Einstein. I begin here with a brief summary of Einstein's philosophy on science and religion, as reported in his bibliographies. I return to these points in the discussion section following Bo's narrative.

Like Bo, Einstein was a mathematician with Buddhist views. Though he was a Jew by heritage, he did not believe in a personal god and instead referred to a "cosmic religious feeling" (1990, I, p. 26). He claimed that Buddhism had a strong element of this feeling. Far from believing that science and religion were at odds with one another, he claimed, "in this materialistic age of ours the serious scientific workers

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are the only profoundly religious people" (p. 28) because they are able to think abstractly and universally. In *Out of My Later Years*, Einstein noted that "the realms of religion and science are clearly marked off from each other" in that they answer different questions (1990, II, p. 26). Still, he proclaimed, "science without religion is lame; religion without science is blind" (p. 26). Much of this thinking is echoed in Bo's story, though there are some notable differences of viewpoint and profound differences in background.

Bo's Narrative

Bo is a 30-year old Chinese man who has been living in the United States for about 10 years. He was raised in a family without religious beliefs, but began to explore his own beliefs as an undergraduate in Shanghai. There he studied philosophy, the Bible, Taoism, Buddhism, and other religions. He found that Buddhism fit his nature: It offered him a "home for his mind to rest." His beliefs were strengthened when he met a group of Buddhists in graduate school in the United States.

When Bo was denied admittance for undergraduate study in physics at the Shanghai University of Science and Technology, he turned to his second choice: mathematics. He found that he was better suited for mathematical study because it offered him freedom that physics did not—there were no experiments or computer skills required in the study of pure mathematics. He went on to receive a Ph.D. from the State University of New York at Stony Brook.

His interests in mathematics were piqued even before college, when he learned about infinity. The infinite still plays a role in his post-doctoral research. He studies operator theory, a branch of mathematics that examines behaviors of objects in infinite-dimensional space. He feels that this research should occupy 80% of his time and energy, while the rest is reserved for teaching.

Cause and Consequence

In Buddhism, there is no personal god controlling things: "Everything is just cause and consequence." In fact, Bo believed in this universal phenomenon of cause and consequence before learning of Buddhism. His belief in the phenomenon contributed to his natural inclination toward Buddhism. Since all is cause and consequence, he cannot expect someone else to save him, and this view countered a major tenet of many western religions he had explored.

> If you do bad things, you are going to be suffering from that in the future. If you help other people, you will be helped eventually. So, it's a cause and consequence kind of thing that I believe. And, I also believe that by purifying one's own soul… you get rid of delusions to see your own nature. You find a way to save yourself.

Bo refers to this purification as "a way to control your own thoughts." This is the central theme of his religion, which provides him with a set of values.

Bo describes thoughts as clouds that come and go. You use good thoughts to do good deeds and evil thoughts to do evil deeds. If an evil or bad thought enters your mind, you can just let it go. "Your mind is like the sky. A cloud is like thought. They go and pass." This approach applies to mathematical study as well. Any thought that distracts Bo from his research is a bad thought. Letting go of distracting, bad thoughts allows him to focus on his research.

Bo emphasizes the importance of being oneself. This value is based on the nature of life. He believes that he is defined as a mathematician because mathematical thoughts are the most frequent thoughts in his mind. In fact, on his failure to gain admission in the physics program of his university he says that "life made a correct decision for me." Rather than ascribing this decision to a mindful deity, he refers to the natural consequence of his failure that suited his nature, embodied by his decision to study mathematics.

"Being a researcher is a value of [one's own] spirit." Bo finds freedom in mathematics, as he has in Buddhism. This openness is common to Bo's nature as well. Perhaps his value of freedom offers further explanation of his affinity for both mathematics and Buddhism. While Buddhism offers him "a feeling of [being] at home," mathematics makes him happy. "If it makes me happy, then I can make friends around me happy."

Making others happy is another important religious value for Bo, and "teaching… is a happy thing to do." Bo describes teaching as "telling other people what you understand" so that they can appreciate your ideas. He likes teaching because it allows him to interact with "vibrant students." He calls teaching "a social value," and feels that it is important to practice patience in the classroom. When students ask repetitive questions or criticize him in his teaching, Bo keeps a peaceful mind. Rather than letting negative remarks aggravate him, he reminds himself "there is no target to be hit" by these remarks and lets them pass by. This orientation, then, is another influence of his religion upon his practice of teaching.

It seems that many aspects of Bo's profession make him happy. It is a part of his nature or Karma, which he knows through a seventh sense—the sense of being oneself (the sixth sense is consciousness). "Your Karma was a seed. So, for example, a person may develop talent for mathematics." Karma is carried in the eighth sense—an ever-present and immense store of knowledge. Because the seed grows, the eighth sense is the knowledge that "grows out of the seed" and is like creation. Because the seed is eternal, attaining knowledge is like discovery. "Many times, we discover a thing that should be there…So I may think it is a discovery or I may think it brings back memory."

In mathematics too, Bo found that it is difficult or even impossible to distinguish between the discovery and creation of knowledge. "Mathematics is like a tree. It's already there, [but] grows different branches…. Only history can tell…. I don't think it's purely creation or purely discovery. It is in between."

Infinite Sequences of Coordinates

The strongest relation between Bo's Buddhism and mathematics exists in the intertwining of the two realms resulting in an epistemology that stems from his belief in cause and consequence. In Buddhism, everything is an image in the mind that is given by objects that we cannot otherwise know. "We cannot say that the thing itself is 'what what.' We can only say that the image it gives us is 'what what.'" In other words, we cannot know an object for what it is, independent of our own unique perspective. Thus there is already a strong epistemology embedded in Buddhism. It includes the belief that our knowledge of objects depends on the observer. "[Bo's epistemology] is an association of objects with numbers, because ultimately we can process numbers in our minds – not an object itself." So, in Buddhism, "everything is understood as a sequence of coordinates." Bo explains that because objects can be seen from infinitely many perspectives, objects must be infinite sequences of coordinates. These are quantitatives, and it is through mathematics that people study quantitatives and their relationships. Thus mathematics is "the way of studying the universe."

In mathematics objects are also viewed as sequences of coordinates. In fact, this aspect of mathematics is the central focus in Bo's chosen branch of study, operator theory. In operator theory, mathematicians study objects and relations between pairs of objects in infinite-dimensional space. Bo's decision to study operator theory may have risen from his initial high school interest in mathematics, infinity. This initial interest in the infinite then may be a common cause to both his religious and professional pursuits.

Bo's religion and mathematics seemed to grow together in many ways. He was drawn to mathematics and Buddhism for at least two common reasons: his nature and his value of freedom. In fact, given Bo's theory of Karma, we can say that it was in his nature to become a Buddhist mathematician. Certainly many ideas and practices from one domain flow to the other. In particular, Bo's view of the world and his means of understanding it are intertwined with his profession and his religion.

Discussion

In discussing each of the three cases from my study, I have used Charlotte Methuen's four categories of historical relationships between mathematics and religion: conflict, independence, dialogue, and integration (1998). These categories provide general contexts from which to examine mathematical-religious influence and to compare these influences within and across cases (both historical cases and those from my study.) Methuen recounted the life and philosophy of the 16th century philosopher, Philip Melanchthon. Melanchthon clearly fell into the last category, claiming, "the study of mathematics offers a vehicle by which the human mind may transcend its restrictions and reach God" (p. 83). Bo is another example of integration, where mathematics is the vehicle to which we are restricted in reaching the universe. Though some disciples of Buddha may have been able to transcend this restriction and "know without thought," mathematics is his primary way of knowing.

Bo seems to share the cosmic religious feeling of which Einstein wrote. He might also agree with Einstein that religion provides an avenue for abstract thought that contributes to scientific study. However, it is not clear for Bo that "the realms of religion and science are clearly marked off from each other". In fact they seem to coalesce into a single realm of thought that is uniquely mathematical and Buddhist, but can be neither of these alone.

Mathematics educators can learn from Bo's example. Though they might stop short of promoting a mathematical religion, there is an element of Bo's view that educators may want to instill in their students. Mathematics may not be the way of knowing the universe, but it certainly provides ways of understanding it. Bo's view is an admission that

A Feeling of Being at Home

There's no ultimate consciousness that creates this world
And sets rules for other things to play.
Everything is just cause and consequence—the universal law.

Buddhism gives freedom and a home for my mind to rest.
I have a new feeling of being settled, and I am finding a way
To save myself by purifying my own soul.

I am responsible for my deeds and thoughts, but to be honest
Thoughts themselves are not distinguished by good and evil.
Fighting in battle, you use evil thoughts. Just be watchful of these thoughts.

My mind is like the sky. A cloud is like thought. They go and pass.
I am defined as a mathematician; I cling to mathematical thoughts.
Centering on mathematical problems, I am using a cloud in a drought.

To thoughts, there's a deep part and a shallow part. The shallow part is
Given by the object that stands in front of you. What is the deep part?
I don't know. Ability of dealing with image & thoughts is immense.

Limit, infinity, derivative - mathematics is a very freestyle subject.
Between creation and discovery, it's like a tree branching out.
Only history can tell, but life made a correct decision for me.

Being a researcher is a value of the spirit, and it makes me
Happy. Teaching—interacting with energetic & vibrant
Students—is a social value. It's a happy thing to do.

Buddhists believe everything is image in our mind.
We cannot really say the thing itself is *what what.*
See the cup? A fly may see this cup in a different way.

Buddhism gave me another way to look at mathematics.
Mutually, mathematics deepened my understanding of Buddhism.
Everything is understood as a sequence of coordinates.

Every element is described in infinite-dimensional space
Everything has the ability to be infinite: every particle,
Every human, every social event, and mathematics…

It turns out to be the way of studying the universe. Or is
Mathematics just one approach humans adopt to study this world?
Ultimately we can process numbers in our mind – not an object itself.

There was one disciple of Buddha who knew things without thought,
Like when I'm thirsty I know I'm thirsty without thought.
He just expanded this capability. It brings back memory and is there forever.

There are things that exist beyond human sensation and we will never know.
But we should have a peaceful mind and remember that, ultimately,
There is no self.

Figure 1: A poetic transcription of excerpts from Bo's interviews.

humans cannot know the universe for what it is (i.e., that an object is "what what"), but that mathematics offers a myriad of lenses for viewing it—perhaps for examining different subsets of the infinite coordinates within it.

This characteristic of mathematics is recognizable in its employment in the sciences. Chemistry, geology and economics (to name just a few fields) all use mathematics in order to explain the biological and sociological environments of humans. By accepting particular assumptions and adopting prescribed methods associated with a field, in a sense one reduces the study of the universe to a few measurable coordinates. After all, these presumptions enable ascription of a cause to a consequence and prediction of phenomena, yet this pattern of assuming and ascribing says nothing about truth except that humans cannot directly perceive it.

There is at least one more aspect of Bo's view from which educators can learn: Each human being has a different view of the universe. Since mathematics is (at least in Bo's view) the human way of understanding the universe, each person might infer that she develops her own mathematics. That is, people use mathematical thoughts as they occur in them to satisfy their own goals. The way people use those thoughts yields consequences that determine their direction in future development. In trying to foster development, teachers must first recognize their students' universes of thoughts and then try to determine the causes and consequences associated with the use of those thoughts. Moreover, in teaching students, teachers must understand what motivates student thinking, else students may let pass the products of teachers' best intentions as clouds through the sky.

Because it admits observer-dependent truths (or at least observer-dependent perceptions of Truth), Bo's religious philosophy for mathematics may be the most desirable for establishing meaning for mathematical activity without conflicting with religious views. Clearly Bo's and Einstein's mathematical philosophies were in harmony with their religions, but Einstein could also have carried on the faith of his Jewish heritage without abandoning his philosophy. In fact, he claimed that Judaism already had present in it an element of this view (1990, I). Certainly in the case of Joseph (the Jewish participant of my study), there was a strong religious respect for science and its role in humanity. In Charles' Christianity, Charles made a distinction between God's knowledge and our own and believed that man was capable only of "wavering toward" divine knowledge through trial and error; thus religious Truth and scientific thought need not conflict and often compliment one another.

Whatever their religions, in all three cases the mathematicians felt the necessity of making religious meaning for their practice and defining the role of mathematics in their spiritual lives. Charlotte Methuen's four categories provide contrasting descriptors for the relationships between the two realms in establishing this role. Though Joseph's Judaism stood independent of any mathematical truth, his practices within the two realms overlapped, and he held a religious value for mathematical study and teaching as meritorious activity. In that sense, the relationship between his two practices was also one of dialogue. For Charles, there was no built-in religious value for his mathematical practice, so he struggled to integrate the conflicting domains and find some religious value for his mathematical practice in serving God. Bo's case provides the strongest example of integration – one that led to an essential meaning of mathematical study in understanding the Universe.

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