THE ZIMMER PROGRAM

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When word of President Robert Zimmer's relationship with classics professor Shadi Bartsch spread in February, it was perhaps the most visible he'd been on campus in months.

After all, student activists called for Zimmer to "step out of the shadows" just last winter. "At some schools, presidents even go to student meetings and participate in campus events!" they wrote on cardboard-cutout Zimmers in the quad. While he now holds quarterly Q&A sessions, attendance is chronically lackluster—never more than two-dozen students or so, including Student Government representatives.

The attention to Zimmer's relationship draws further focus away from one of the least publicized aspects of his career. Before he was president, before he was provost at Brown University, before any of his administrative work, he was a powerful mathematician who carved out a complex discipline that now bears his name: the Zimmer Program.

AT THE BOTTOM OF THE TOTEM POLE

Working on his Ph.D. at Harvard in the early '70s, Zimmer was interested in the relationship between dynamics, the study of repeated transformations, and Lie theory, an area of algebra that studies symmetries.

"The two fields were absolutely disjoint," said Benson Farb, a U of C math professor whose work relates to Zimmer's. Before Zimmer's dissertation, only four papers had ever been published on the interaction between the two fields. Zimmer's thesis was one of the first to significantly address both areas, becoming one of many of his characteristically interdisciplinary papers.

This work would eventually lead to the Zimmer Program, an area of mathematics that covers an even broader range of fields, and that's now studied by about 100 mathematicians around the world.

"Often, phenomena are isolated. Zimmer's Program was somehow deep in that sense," Farb said. "He found a very rich vein of stuff. It's very hard in mathematics to find areas of study that are rich enough to support lots of people working on them for long periods of time."

Yet even with his groundbreaking dissertation, Zimmer was cornered into one of academia's more undesirable jobs, at the U.S. Naval Academy in Annapolis, MD.

The Academy, which focuses on training engineers, has a heavy course load, with many professors teaching seven classes a year. Many University professors bristle at teaching more than three, saying it takes too much time away from their research.

"As far as academic jobs go, that's near the lowest on the totem pole you can get," Farb said. "You don't want to be at the Naval Academy. You want to stay in mathematics. You have to prove theorems."

The recommendation of Zimmer's thesis adviser, George Mackey, was not persuasive enough to net him a top position, said former University math professor Jerry Bona, now at the University of Illinois-Chicago. "Mackey had scads of students and this letter wasn't his best. Bob's dissertation was good, but remember, this is Harvard," said Bona, who got his Ph.D. from Harvard a few years before Zimmer.

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Zimmer himself has little to say about why he went to the Naval Academy, other than that it's "a complicated story." But he admits he stood out among his colleagues: "I was different than most of the people they had on the faculty there."

Despite landing a less than ideal post after graduation, Zimmer's time at the Academy was one of the most prolific in his career. In his two years there he wrote 11 papers that were published in prestigious journals—the most over any two-year period in his 35-year career—all while teaching more courses than he would have almost anywhere else.

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COMING TO CHICAGO

Zimmer's success was due not only to his mathematical prowess, but also to his self-discipline.

"He was the most organized mathematician I had ever met," said University math professor Shmuel Weinberger, who was hired in the mid-'80s. "He wore a tie. His papers were neatly stacked. He would make appointments in advance instead of going from conversation to conversation. All of this sounds so elementary that you'd think that any normal person would do it, but that's not they way most of us mathematicians worked."

The Academy gave him all morning classes, Zimmer says, and the rest of the day was reserved for math.

"I would teach from 8 to 12, and that left me from 12 to midnight to do mathematics," said Zimmer, who never pulled an all-nighter as a researcher. "There's a lot of time in the day if you use it all."

The schedule worked for Zimmer because he would become obsessed with whatever problem he was working on. "Even when I was doing something else, I was parallel processing because it was so absorbing," he said.

While at the Academy, Zimmer built a body of work that would eventually become the foundation for his program. His papers explored an intersection of two typically unre-

lated fields, a developing area that wasn't in vogue at the time. "I was working on a set of things with a particular point of view that was not very popular, but that was just the way I naturally thought," Zimmer said. "At the beginning it was very—lonely is an exaggeration, but it was not a journey that had a lot of fellow travelers."

Zimmer's papers impressed his old adviser, Mackey, who wrote him another recommendation letter. In 1977, two years after Zimmer came to the Naval Academy, he once again applied to more prestigious schools, including the University of Chicago. Bona, then a recent hire at the University, was on that year's search committee. Being "young and silly," Bona pored over every applicant and took notice of Zimmer.

"I read Mackey's second letter and it was off the scale. Mackey just didn't write letters like that," said Bona, who added that Mackey called Zimmer his best student. "Most of my colleagues had passed over him because no one thought they'd want someone from the Naval Academy."

THE ONLY MAN WITH A TELESCOPE

While Zimmer became an instructor in the math department here, Grigory Margulis, a Russian mathematician, was about to win a Fields Medal—the math equivalent of the Nobel Prize—for exploring the junction of Ergodic theory, a type of dynamics, and Lie theory, the same general areas Zimmer studied.

Margulis's paper proved that mathematical objects called groups could be super rigid, which meant they could only have one structure—if you took one apart, there was only one way to put it back together.

The complexity and interdisciplinary nature of Margulis's work meant that only the handful of mathematicians who knew dynamics and Lie theory—like Zimmer—understood its full implications.

"It was as if there was a supernova, but nobody had a telescope except Zimmer," Farb said.

"It's still astonishing when I think about it," Zimmer said. "There weren't enough people who were well-enough versed in both [fields] to actually read the paper and have some appreciation for what it was. Everybody appreciated Margulis's result as amazing—but they didn't understand the nature of his arguments."

Zimmer read Margulis's "cryptic" paper and soon realized how it would influence his own work. "It was one of those magic moments when you understood what he had done," Zimmer said.

By 1979, Zimmer had written a paper of his own—"Strong Rigidity for Ergodic Actions of Semisimple Lie Groups"—that extended Margulis's result for objects called cocycles. The approach, his colleagues say, was groundbreaking.

"Zimmer's insight was that Margulis's work, which was originally in a linear setting, applies to an extraordinarily wider range of objects," Weinberger said.

The paper sparked the attention of the nation's top math departments, who eventually attempted to recruit him.

"When Bob proved his rigidity theory, all of a sudden, he was no longer an instructor," Bona said. "We saw that we needed to keep him and make clear what our intentions were, and so he became an associate professor." He was appointed full professor the next year.

Still just a few years after Zimmer's unexpected stint at the Naval Academy, the paper's reception bolstered his confidence. So much so, in fact, that when his wife needed to travel behind the Iron Curtain to Tashkent, now in Uzbekistan, to study Soviet economic policy, Zimmer spent six months with her, a move some would have considered "academic suicide," Bona said.

"It would be like you going to Antarctica for a while. It wasn't necessarily good for his career," Bona said, referring to being cut off from much of the world's academic conversation. "But Terese's academic life was on the line, so he went.... By now, he was reasonably confident in his abilities as a mathematician, so he knew he could survive."

Zimmer later reported to colleagues, including Bona, that the KGB had bugged his

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apartment in Uzbekistan. He described Tashkent as "definitely isolated"; but while there, he was able to meet Margulis.

Margulis, who now teaches at Yale, fondly remembers the meeting. "We talked about his impressive work, and joked about the secrecy they kept my Fields Medal under," Margulis said. "It was an inspired conversation."

THE BOLD AND CRAZY PROGRAM

Over the next few years Zimmer's work elaborated on his rigidity paper, proving special cases of what would soon become the Zimmer Program. Although the moniker can't be traced to any one paper or person, the ideas that would define the Program stem from a talk Zimmer delivered in 1986 at the International Congress of Mathematicians.

There, he outlined his thoughts on what transformations of his much-studied Lie groups might satisfy certain properties, like preserving volume. In doing so, he painted a broad vision of what could conceivably be true in the intersection of all three major disciplines of math.

"It was bold and crazy," said Weinberger, the U of C math professor. "It's hard to take something really wonderful, like, 'Truth is beauty,' and say something concrete with it, like 'Therefore, the Mona Lisa is true.' But the Zimmer Program was fruitful because it suggested all sorts of special problems that were tractable by many different means."

The Zimmer Program is "the best kind of science," Farb said. "You have the big conjectural picture of how things work—and these are incredibly complicated things we're talking about—and then he provided very concrete evidence on why we should take his stuff seriously."

Zimmer's ability to take problems from one discipline and answer them with tools from another meant that his theories were approached by an extremely wide range of mathematicians. That included a young

Theorem 4.5. Let $\Gamma \subset G$ and $\Gamma' \subset G'$ be lattices in connected simple Lie groups with finite center, and suppose the real rank of G is at least 2. If S and S' are (essentially) free ergodic $\Gamma-$ and $\Gamma'-$ spaces (respectively) with finite invariant measure and the actions are orbit equivalent, then G and G' are locally isomorphic.

In particular, we obtain the following result.

Corollary 4.6. Let $SL(n, Z)$ act on the torus $\mathbb{R}^n/\mathbb{Z}^n$ by automorphisms. Then for $n, p \geq 2, n \neq p$, the actions are not orbit equivalent.

Let λ: S $\to \tilde{G}$' be $\lambda(s) = \theta(\Phi(s))$, so we have $\theta(s) = \Phi_0$. Thus (**) becomes

$$\Phi_0 \bullet \lambda(sg)\alpha(s, g)^{-1}\lambda(s)^{-1} = \phi_0 \bullet g$$

It follows that for some $h \in H$ and some conjugate G_1 of $\sigma(\tilde{G})$ that

$$G_1 \subset hNh^{-1} \cap N_H(j) \cap \bigcap_i N_H(\mu_i)$$

Excerpts from Zimmer's 1980 paper "Strong Rigidty for Ergodic Actions of Semisimple Lie Groups."

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Weinberger, who thought because the Program had so many implications that he could quickly discover some flaw.

"It didn't happen," Weinberger said. "First, none of the roads were that easy to work out, and then I kept on discovering that it was true whenever I could figure out what was going on. But in each road, it was true for a different reason."

Margulis said that with the Zimmer Program, their relationship came full circle. "In the beginning, I influenced him more than he influenced me," Margulis said. "But now his work influences mine."

Zimmer downplays his Congressional talk, saying it's "gratifying" that so many others have added to his theories. "I merely thought about it as a large and systematic program with lots of questions," Zimmer said. "Now people bring different techniques to bear, coming from directions I have not thought about. That's just fun to read."

THE NO-FLUFF ZIMMER

By the early '90s, Zimmer was chair of the math department here, and was promoted to associate provost for research and education, then deputy provost for research, then vice president for Argonne National Laboratory—all within a decade. His decision to enter the administrative ranks surprised some, but Zimmer's motivations are clearer when considering how thankful he is to the University for hiring him.

"The University had enough confidence to take a bit of a chance on somebody who was doing something very different," said Zimmer, who "tried out" Berkeley for two years in the '80s before returning, according to Bona. "I just wanted to contribute in whatever way I could in enhancing that environment of supporting and encouraging research."

That approach colors Zimmer's policy decisions as an administrator. "If there's one thing that drives him as president, it's that Chicago

remains the best place for faculty," Vice President for Strategic Initiatives David Greene said. "Everything else flows from that: the kind of students that will come here, the quality of the scholarship, etc."

Colleagues and former students drew connections between his personal, mathematical, and administrative styles, describing him as consistently direct in his presentation of new ideas and never one to brag.

"His personality is absolutely reflected in his mathematics," said Farb, whose family is friends with Zimmer's. "There's no fluff to his mathematics."

Farb says some math papers use "heavy advertising," claiming grand results in their introductions, and name-dropping prominent mathematicians.

Zimmer never used those tactics. "He would just start out, 'Let S be a finite set of places,'" Farb said. "He definitely outlined a series of conjectures and built up a body of work, but he never said, 'This is my big program,' which a lot of people do. It was a quietly successful program."

Zimmer said that was his philosophy when writing papers. "The mathematics should speak for itself," he said.

Perhaps that's why students who know Zimmer best for refusing to divest from Darfur or announcing last year's budget cuts without fanfare, sometimes see him as distant. "Zimmer is all about content," Farb said. "Now maybe going to a football game and making appearances is part of content. But which is better: that he spends his time going to appearances or that he goes to a donor and makes sure he gets a contribution?"

Zimmer admits he doesn't needlessly adorn his work ("He jumps right into the substance," Greene said of Zimmer's speeches.) But Zimmer said he's not sure about if there are any meaningful links between his academic and administrative styles.

"One can always draw analogies, and you have to ask yourself whether you're drawing analogies or some deeper connectivity," Zimmer said. "I'm not sure what the answer is there. I'm sure there are certain kinds of thought patterns, ways of approaching things, that go across, but I've never really thought about what those are."

"THE CONJECTURES ARE STILL PURSUING ME"

Colleagues are impressed by the energy that allowed Zimmer to publish and teach at the Naval Academy and still allows him to juggle math and administrative work. As math department chair, Zimmer continued to produce as many papers as a full-time researcher—and as University president, his most recent paper was published last year.

Provost Thomas Rosenbaum laughed when asked about Zimmer's energy before explaining Zimmer sends e-mails to other top administrators well past midnight. Weinberger also marveled at Zimmer's time management. "He must have found a way of tapping those scrap minutes between meeting that are usually just thrown out," he said.

It's because many key pieces of the Zimmer Program remain unsolved that Zimmer is compelled to keep exploring his Program.

"I can't escape these things," Zimmer said. "The conjectures are still pursuing me. Every now and then they catch up and I'm trapped reading these papers, trying to solve them."

But with his days filled with meetings, Zimmer no longer has as much time to devote to research. When he does take time to keep up with current theories, it's targeted toward ideas that could apply to his unsolved problems, mentioning, for example, a paper on Riemannian metrics he read on a recent plane ride. "I will confess that I was reading that paper with the question of whether or not there was some idea there that could be applied to solving these things," he said.

Zimmer quickly added that despite the urge to keep at his Program, the demands of being president almost always win out. Zimmer's two latest projects were both co-authored, including a book with former student David Morris (Ph.D. '85). "The flow of ideas was basically one-way," Morris said. "Bob came up with great ideas, told me I should check them out, and I worked out the details."

But being so pressed for time hasn't diminished the powerful hold math has had on him since college. "It was too beautiful to describe," Zimmer said. "It's still unbelievably beautiful."