TEMENOUJKA BANDROVA

Building on her love of drawing and math

TEEN WHO PREFERRED athletics to studying in class, accomplished cartographer Temenoujka Bandrova explains how she turned her childhood love of architecture into building something even more expansive—comprehensive atlases for all the schoolchildren in Bulgaria.

Temenoujka Bandrova stands in front of a wall map of the Balkan Peninsula she designed with atlases she created for Bulgarian classrooms.

Temenoujka's atlases in geography and history are used by all third- through twelfth-grade students in the country. As a professor of cartography and president of the Bulgarian Cartographic Association (BCA), Temenoujka said, "As a young girl, I wanted to become an architect. But later in my teenage years, I did more sport than training in painting and drawing courses. So I was good enough in mathematics but not enough prepared for exams in drawing."

Still, Temenoujka loved to draw. That inclination and her propensity for math may be what drew her to cartography, she said.

Instead of architecture, she took up another program at the Higher Institute of Architecture and Civil Engineering (HIACE)—geodesy, photogrammetry, and cartography. "I chose it because of cartography and GIS," Temenoujka said. "This is a system which gives you a possibility to do so many things with geoinformation, and one of all the applications is a map, many

maps, and a subject where everybody can be the author of a map—like an architect is the 'author' of a building."

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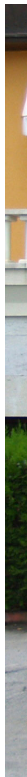
Now the head of the Laboratory on Cartography at the University of Architecture, Civil Engineering, and Geodesy (UACEG) in Sofia, Bulgaria, Temenoujka described how her diverse interests converged. "As a child, I was very good in mathematics. From the other side, I liked to draw a lot." Both abilities are integral to cartography, she said, perhaps most especially math.

"The map starts with map projection. This is connected to the knowledge of math," Temenoujka explained. "For a map to be well designed, one of the first tasks of a cartographer is the right choice of map projection." Without the correct projection, a map can not only fall flat but also be inaccurate, she said.

During her studies at the Faculty of Geodesy at HIACE, Temenoujka concentrated on large-scale topographic maps. Later, as an assistant professor at UACEG, she left her country for three months for a fellowship from the Austrian Foundation of Sciences (one of 10 out of 200 candidates) in Graz, Austria. Then, after winning a travel award from the International Cartographic Association (ICA) and a trip to America, she discovered new interests. Back in Graz, the young scientist created a cartographic symbol system for 3D city models. "This was a very new topic" at the time, Temenoujka said. Now that the majority of citations to her work center on 3D, she realizes she has found her calling. "Now I know that this was the right way," she said. "Later, I encouraged and taught a lot of students in 3D cartographic modeling." With many of her doctoral students doing their theses on this topic, Temenoujka said the subject has become "one of the favorite disciplines that students of geodesy and cartography have in their education."



But cartography wasn't always the go-to subject. Temenoujka remembers how she had to persevere to get her field recognized as a viable discipline. "Like in many countries, also in Bulgaria, cartography is included as part of more broad sciences like geography and geodesy," she said. "In such cases, it is not so easy to make your lovely cartography visible in society and to have freedom for development." Moreover, Temenoujka said, "Some colleagues tried to underestimate the work and achievements of cartographers." And some even tried to stop the creation of the BCA to begin with, seeking to keep cartography limited to their own profession. But the realization that cartography was, in itself, useful in many professions won out—and today, on an international level, Temenoujka is also the vice president of the ICA and treasurer of the International Society for Digital Earth. As president of the BCA, she has organized the International Conference on Cartography and GIS (ICCGIS) every two years since 2006. The next one, the eighth, will be in 2020.

Temenoujka (*bottom middle*) stands with participants at the Fifth International Conference on Cartography and GIS, June 2014, in Riviera, Varna.

Attendees at a conference that Temenoujka organized are evacuated by military helicopter from Riviera, Bulgaria, after a devastating rainstorm washed out the roads.

Temenoujka recalls how at the fifth ICCGIS, in 2014, more than 100 guests were staying in Riviera, a woodsy spot 20 kilometers from the conference in Varna, Bulgaria, for a gala dinner. "Suddenly, very strong rains came, the small river jumped to five meters of water, and the road was destroyed," Temenoujka said. "There was not a chance for our buses to cross the river." As floodwaters rose, and Varna suffered 10 deaths, conference participants visiting from more than 30 countries, with many missing their flights, were left to wait it out for a nervous night until they could be evacuated by military helicopters 20 hours later. "I thought about stopping the conference series after that story," Temenoujka said.

Cartography has had a personal impact on Temenoujka in many ways. When her two children were starting in the primary grades in elementary school, she came to a life-changing realization when she saw that their classrooms used the same atlases and maps she had used as a child. So she decided to use her expertise and update all of them to current standards.

"I decided, I am a cartographer. I should make for all Bulgarian children better, modern maps and atlases, different from the previous ones and more interesting for them," Temenoujka said.

Now she has authored atlases for every grade and plans to continue updating them, along with the help of her current crop of PhD students, who will carry on the work. Temenoujka enjoys being a mentor to her students, many of whom call her "mom."

"I become close friends with all my diploma and PhD students," she said, "and I am sure that my achievements will not die—these young people will develop our common ideas and work. In this way, my already old atlases will become modern, and more and more interesting for children."

Even so, the atlases on history have proven a little trickier for Temenoujka than the ones on geography.

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Temenoujka (*right*) and nine-year-old third-grader Alexandra hold up part of a PhD research questionnaire containing training exercises for disasters in Bulgaria. PhD student Denitsa Savova is at center.

Temenoujka (*left*) with one of her students, Elena Dunkova, at the Bulgarian Parliament, at an exhibition for the International Map Year 2015–2016, surrounded by maps of Bulgaria that Temenoujka created.

One of the difficulties she found in school was understanding the complicated Bulgarian history in antiquity and the Middle Ages. It's a conundrum shared by former US president Bill Clinton, she said.

"Clinton writes in his book *My Life* that one of the most difficult exams for him was to write Balkan history in a small number of pages. So now I am not only an author of atlases in geography, but also an author of atlases in history. I never dreamed I'd be a cartographer, but now this is my life and love," Temenoujka said.

In addition to atlases, she also creates wall maps for schools and does research on 3D mapping and cartography for early warning and crisis management. In her work for the ICA, she garnered international cooperation on how to prepare better maps for children in disasters, with emphasis on how children understand geoinformation represented on a map, how cartographers could represent objects on a map, and what symbols they could use, among other topics. These experiences are printed in several publications.

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If you have STEM in your heart, indulge in this profession. Such a profession gives you the freedom to think, to develop yourself, to be yourself!

Before her career in education, as a young mother, Temenoujka worked in the map department for a forest engineering company for five years. Then for two years, she worked for the National Cadastre as an expert on an EU Copernicus research project with Slovakia and Germany. After that, she passed the exam to become an assistant professor at UACEG, formerly HIACE.

Through it all, it's her love of the science and paying it forward that she finds most rewarding. "My professional achievement is to be a cartographer and make meaningful products to help the educational process."

Wanting to influence the young people around her, Temenoujka said, "I always think that the best education is a good example."

And so, she finds special delight in seeing how her atlases for the classroom have sparked the curiosity of schoolchildren about the world around them.

"One day I was coming home by metro and saw two boys around 10 years old who were browsing my atlas for grades 3–4 and really enjoying it, playing with it, and at the same time learning new things. At that time, I said to myself, 'This is my prize. This is much more than money, awards, or diplomas,'" Temenoujka said.

Mentored by her father, who gave her history lessons in the park, Temenoujka encourages young women who are motivated to enter the science, technology, engineering, and mathematics (STEM) fields.

"If you have STEM in your heart, indulge in this profession. Such a profession gives you the freedom to think, to develop yourself, to be yourself," she said.

While she understands that motherhood is an important and time-consuming endeavor, she urges young women not to give up on their other pursuits.

"I am a person who does not regret her decisions in life. But now I also know that life is too short to doubt and wait for destiny to decide for you.

"Every woman has to do what she loves to be happy," Temenoujka said. "Be a mother, but don't spend all your time with family. Keep your profession alive, and always cultivate yourself. Do what your heart and soul suggest."

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Korean colleagues show Temenoujka (*second from right*) and Georgi Gladkov (*second from left*), vice president of BCA, the high-technology systems of Samsung.

As for the future, Temenoujka says that the spread of digital information has changed people's lives, making everything easier and faster. But with all the possibilities that lie ahead, one thing is clear: "All this information, called *big data*, should be in the hands of very responsible and good people. No science can exist separately. More and more integration between scientists will be needed," she said.

It's a spirit of sharing and cooperation that she has long fostered. Through her work promoting the spread of knowledge and information through cartography, Temenoujka is striving to ensure a safer, more unified world. "I hope very much for a peaceful future," she said, "and clever caring for our planet, which is our home." ✦

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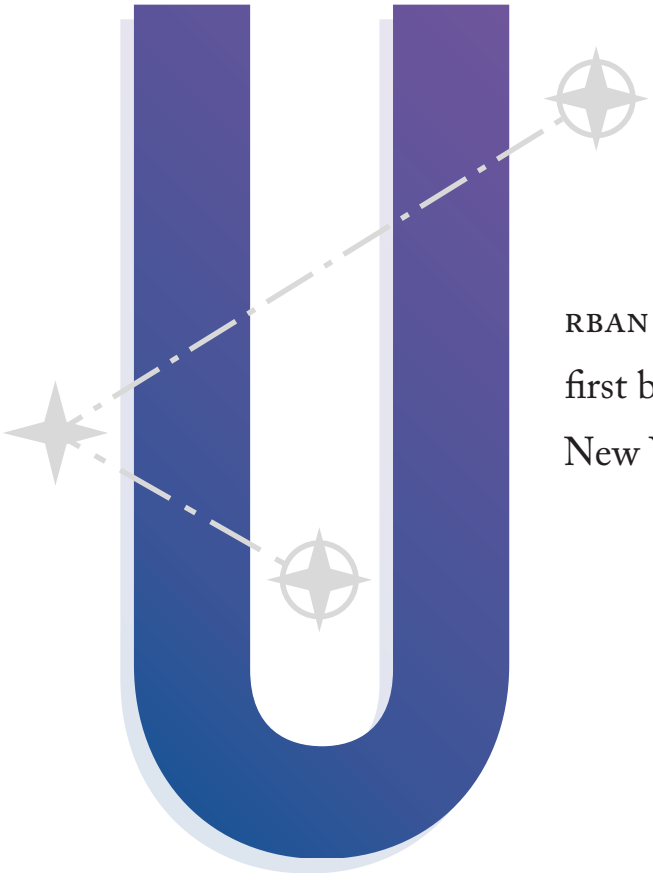
ASHALI BHANDARI

Planning for a more resilient India



URBAN PLANNER Ashali Bhandari's love for cities first began when she moved from a suburb of New York City to Mumbai, India, at age 11.

Ashali Bhandari in Goa on a geography field trip, experimenting with ways to measure beach erosion.

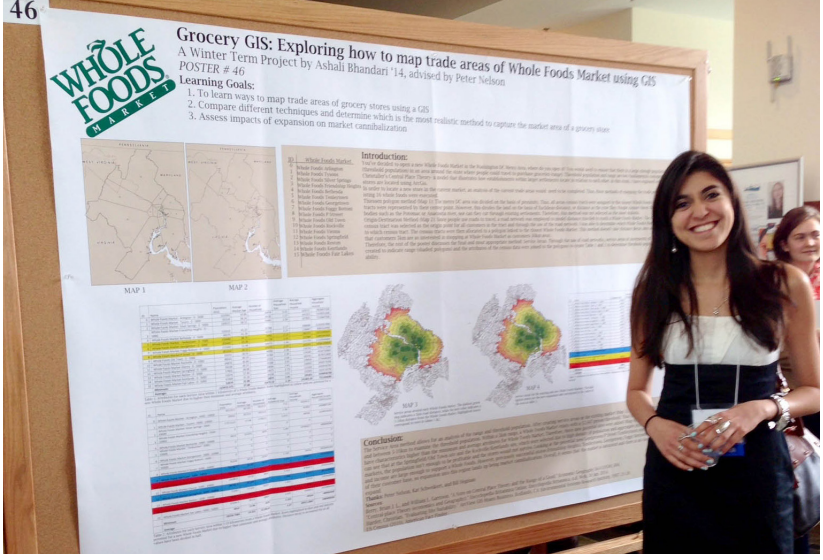
Her entire life changed, and while it was challenging at first, she fell in love with how dynamic and exciting city life was. The festivals in the streets, the people walking everywhere, even the fact that her neighbors now lived above and below her instead of across a fence was so different from her previous home. But it also exposed her to more poverty than she had ever seen in her bubble in New York. "As a young girl, I would see another girl around my age selling toys or flowers to passing cars and wonder why they couldn't go to school like I did. And when the monsoon season began, I would wonder where homeless communities would seek refuge from the downpour."

That interest in cities and urban poverty, especially during extreme climatic events, has stayed with her. Today, Ashali works with the Urban Resilience Unit—pioneered by the 100 Resilient Cities program (now the Global Resilient Cities Network)—at the National Institute of Urban Affairs in New Delhi, India. "In many cities in India, decisions are made without the decision-maker having a complete picture of the challenge. This is because datasets are often not shared beyond the institution that collects them, datasets may be outdated, the scale or resolution of the

data isn't applicable, or the format of the data may be challenging to use," Ashali explains. Some decision-makers may not even be aware of how different datasets can come together to help them make decisions. "When it comes to resilience, it's important that the underlying and basic systems within a city are strong, so that when the city faces a shock or disaster, it's able to adapt and bounce back more efficiently. I am helping put together a decision framework to help decision-makers understand how datasets can be used, where they can be sourced, and how often the data is needed to help them answer questions to solve the challenges they are working on."

Ashali's path to becoming an urban planner started early. "I always loved social science, and geography was always my favorite subject," she said. She remembers one field trip—a one-week visit to Goa, a coastal state in India, to learn about coastal ecosystems—as one of the most memorable experiences of her life. Her geography teacher, Mr. John Haeusler, encouraged students to understand the longshore drift in creative ways, mapping the flow of the waves using floating balls and observing how they moved, and measuring the angle of the swash and backwash to see whether the beach was eroding. It taught her to value the power that nature held.

She graduated from Middlebury College, a small liberal arts college in Vermont, with a bachelor of arts in geography. During orientation, before she had picked her major, she met a few professors in the geography department and felt a pull toward the subject. She dabbled in a variety of classes, from dance to French to political science, but she always felt the most excitement for her geography classes. One of the hardest but most rewarding classes she took was Introduction to GIS by professor Jeff Howarth. "He taught GIS in a way that both communicated how the software



Ashali's final capstone project at Middlebury College involved exploring the distribution of grocery stores across a city to gauge market opportunities for new retailers.

worked and how the tools could be applied for problem solving," she said. "His classes were amazing because they blended the theory of a new software with utility of the tools. Overall, this made for a great class because I was able to think about GIS as a tool to help solve problems in a creative way."

After graduating, she worked three jobs—almost all her work was either grassroots community work or participatory planning and governance research. She worked full time with Studio X Mumbai, a research lab studying rapid urbanization in India that was associated with the Graduate School of Architecture, Planning, and Preservation at Columbia University. She also worked part time with a start-up called Megapolis India and wrote a monthly blog on creative solutions to urban poverty challenges for Bangalore and Mumbai on the URB.im website. She volunteered with an organization called Apnalaya, which worked on community development in one of Mumbai's poorest areas, near the landfill.

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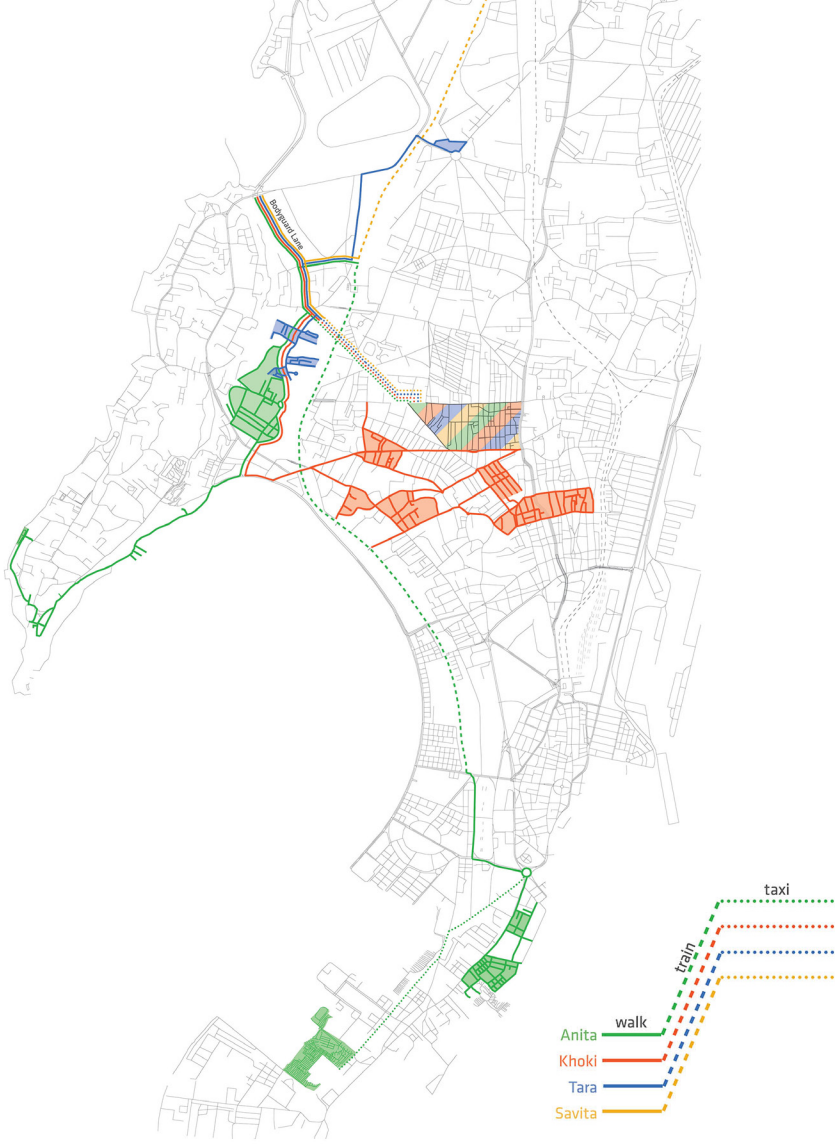
Ashali considers her biggest achievement, though, to be a project she worked on for a year with both Megapolis and Studio X Mumbai. With Megapolis India, she worked with Pehchan, a nonprofit organization, to understand intergenerational homelessness, especially for women in South Mumbai.



A map that Ashali created showing the long distances and means of transportation that four homeless women use to commute to work every day in Mumbai. The map is intended to dispel the stigma around the gendered homeless population in the city.

"The stigmas around the homeless community in Mumbai suggest that the homeless are lazy, new migrants who beg instead of look for a job," she said. "Through my work, I wanted to break down those stigmas and showcase the stories of women who have been living on the streets of Mumbai for decades." This research included capturing the stories of women and families, as well as mapping the livelihoods of four women and how they travel through the city by foot to recycle and sell old clothes and dishes. This work came together in an exhibition at Studio X Mumbai and was featured in an article in *Next City*, an online magazine.

One of the biggest challenges Ashali faced was collecting the data about the routes and patterns of travel for these women. The women were not literate and were not able to understand certain spatial concepts. With no budget to buy GPS devices, and with their hectic schedules, Ashali didn't want to intrude or reduce their efficiency at work by constantly tagging along and asking questions. Instead, they came up with a system in which the women explained their directions using physical landmarks along the way, such as bus stops, restaurants, and drugstores. Once Ashali was able to locate these landmarks, she digitized them, highlighting the efforts these women made in order to work.

Another logistical challenge was the lack of data available for Mumbai, one of the largest cities in India. For the exhibition, Ashali wanted to map the distribution of homeless communities across the city by age and sex, but there was no data available at either the city or the ward level. The number of "houseless" communities is all that's counted in the census, so she worked with those numbers, but even the number of homeless shelters and details about housing were not available. Luckily, the exhibition turned out to be a huge success, and many of the women Ashali worked with for both the mapping and the storytelling were happy to come to the exhibition to see their stories finally being told.

Ashali (*upper middle*) speaking at TechCamp Mumbai 2019. She is addressing an audience from India and Afghanistan about using data to design buildings that are resilient to shocks and stresses.

t's that optimism and perseverance that are Ashali's greatest strengths as she works to help the city she loves. No matter how challenging the situation, her curiosity always drives her to find a solution or way to work around an issue. This drive enables her to keep working, no matter what challenges crop up along the way. It's what helps her to keep working on issues such as data use in cities across India. "I don't want to give up, because I recognize the value, and I believe there are ways to communicate the need and value of sharing data," she said.

Ashali's hope is for young practitioners today who work in design and architecture in India and across South Asia to think consciously about putting marginalized communities at the center of decision-making and planning; this means having more women working in those fields. "Cities are designed to cater to the needs of men," she said. "Women need to be part of the decision-making process to ensure gender equity in planning and the future of cities. I think that, especially in South Asia, cities are being planned, governed, and researched mostly by men. We need other perspectives to integrate the needs of all genders in our communities."

Ashali presenting a token of appreciation to one of the women who took time out of their busy lives to help with her research on livelihoods and gendered homelessness.

And while Ashali believes there are more women now aspiring to be planners and designers in cities, the leadership roles in most organizations are still held by men. She encourages women not to be scared to broach topics with senior leadership because they are men. In her own experience, she has found that men are more accepting and willing to listen to and acknowledge a female perspective than she would have thought, so she is now more open about the need for safe sanitation for women, safe transportation, and public spaces in conversation.

She considers Carlin Carr, the founder of Megapolis India, her biggest influence and mentor. Carlin pushed Ashali to write for URB.im, helped edit her articles, taught her how to conduct effective interviews, and showed her how to navigate communities she wasn't a part of without being intrusive. "She pushes me to think critically about where I want to be and what I want to be doing," Ashali said.

Carlin's work with vulnerable populations in the city made a big impact on Ashali; returning to school for a master's degree in city and regional planning at the University of Pennsylvania, Ashali

focused on community and economic development planning. In her second semester, she took an environmental modeling course that integrated GIS and R (a programming language widely used in statistics and data analysis). The prospect was daunting because Ashali had no experience in coding, but she felt that the possibilities were endless with the tools. In that course, she helped create a model to predict areas likely to flood in a city, a process she wants to use eventually in her home of Mumbai, which is extremely vulnerable to flooding.

When she thinks about the future, Ashali says she wants to return to community development and focus on climate change. "Climate is a very real challenge that we need to acknowledge, address, and confront with innovative solutions," she points out. She sees a future where climate action is an initial consideration for any project, as opposed to a burden for many projects. "We live in a changing world, where the challenges of today are multifold, and climate action is an extremely important area of research in this part of the world," she said. "We need more information to make informed decisions."

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Ashali addressing Indian planners at TechCamp Mumbai 2019 about the need for data-driven decision-making to deal with disasters such as floods.