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 RESEARCH 

*A neuroscience study on gaming with esports booster Comcast is the latest project orchestrated by the Drexel Solutions Institute as it remakes how higher education collaborates with external partners. \_by Lini S. Kadaba  
 \_photographs by Jeff Fusco*



**I**NSIDE THE GERRI C. LEBOW HALL at Drexel, marketing doctoral student Hongjun Ye settles in front of a computer and launches *Overwatch*, a popular online multiplayer videogame. For the next several minutes, she defends a payload by peppering enemy bots as they try to duck behind the stone pillars of a red pagoda in a futuristic world. “I like to play video games,” allows Ye, who is a fan of *Overwatch* as well as other first-person shooter games such as *Counter-Strike* and *Borderlands*. But this was much more than downtime from the demands of a doctoral degree. The gameplay inside LeBow’s Behavioral Lab was a dry run for a cutting-edge neuroscience research project involving military veterans that Comcast NBCUniversal contracted with Drexel to design, develop and conduct.

“I really like industry-based projects,” Ye says, during a break from the game. “Students cannot just conduct experiments in the lab and talk about everything in terms of pure theory. It has to connect with the real world.”

Fellow researcher Adrian Curtin agrees. “You consider the impact,” says the post-doc, who was drawn to the project by his research interest in non-invasive neuroimaging. “A lot of times, when you deal with research, you’re focused on knowledge: I want to discover how this works, because I want to know how that works... Working together with private companies gives you a different perspective, a different way to think.”

Adds Ye: “This is a perfect opportunity.”

It’s an opportunity that may never have occurred but for the existence of a unique resource within Drexel called Drexel Solutions Institute. The institute plays a matchmaker role in connecting industry partners with the University’s academic research enterprise.

Formed about five years ago as Drexel Business Solutions Institute within the LeBow College of Business, it expanded to a university-wide role in 2019 and dropped business from its name. Now, the three-person unit serves as a gateway for companies, nonprofits and governmental entities to partner in a fee-for-service model with Drexel faculty and top students on customized engagements that range from targeted research to co-designed curricula to tailored workforce training. Project fees typically range from \$10,000 to \$200,000 to cover the expenses of faculty members’ time and project management.

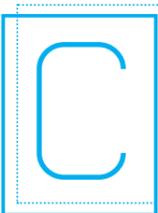
“Organizations have a one-stop shop to access Drexel’s diverse expertise,” says Anna Koulas, who, as vice president of DSI, helps to identify and cultivate partnerships. “DSI is bringing together the best of Drexel.”

So far, dozens of faculty members and about 280 students of all levels have worked with outside organizations on 18 projects coordinated by DSI. In addition to the esports study for Comcast, faculty and students have helped business partners gauge the sustainability impact of a clean water project in rural India; create a one-of-a-kind experiential program for a social services nonprofit; assess consumer responses to PECO’s dynamic utility pricing models; and market test a new hot beverage machine for coffee company Lavazza.

This way of arranging external research opportunities on behalf of the entire University — orchestrated by a dedicated, in-house unit — uniquely complements Drexel’s orientation toward practical coursework, interdisciplinary scholarship and real-world co-op experience.

“In a lot of these relationships, we’re looking to create new pathways for collaboration that have not traditionally been avenues for academic institutions to partner with industry,” Koulas says. “We forge new areas of innovation. We also show them the value of our expertise and resources.”

By all accounts, the DSI model is rare in higher education and sets Drexel apart from its peers. “A lot of universities do projects,” says Michael Howley, a clinical professor in LeBow’s marketing department who has participated in numerous DSI engagements. “But they can’t do it at the scale we do, reaching across the organization, identifying expertise, pulling students onto these projects. That’s really unique.”



**COMCAST VETTED OTHER POTENTIAL** partners for the esports project, but “Drexel stood head and shoulders above the rest,” says Rebecca Gray, executive director of the company’s Military & Veteran Affairs program. “We want academic research, the quality of research that Drexel is going to produce,” she says.

Comcast also liked that the hometown university — in addition to its global reputation, its emphasis on outcome-based experiments with practical social impact and its inclusion of student researchers — is a Yellow

Ribbon school with a strong commitment to veterans, like Comcast’s own. And the two have a long-standing relationship through the Drexel co-op program.

In presenting Comcast with the University’s custom research capabilities, DSI leaders proposed a research design that married Comcast’s expanding footprint in the billion-dollar esports segment to its interest in engaging with veterans, many of whom happen to be drawn to first-person shooter games that, like *Overwatch*, involve working as a team to accomplish a goal.

Comcast was well aware that gaming was popular among military veterans (in 2018, the U.S. Army announced an esports team and the U.S. Department of Veteran Affairs surveyed vets on the topic), but the company wanted more knowledge. “What we want to do is understand more of the why,” says Gray, “and can we utilize that information to impact our business decisions and our gaming efforts and esports efforts? We want data and insight to add breadth and depth into this area, and to connect with and serve the military community.”

DSI assembled a team of interdisciplinary researchers to manage the project, including Rajneesh Suri, vice dean for research and strategic partnerships and the academic lead for DSI; Lauren D’Innocenzo, an associate professor of organizational behavior at LeBow; and biomedical engineering Associate Professor Hasan Ayaz. A team of nine post-docs, graduate and undergraduate students also signed on to the effort.

As Suri and Ayaz discussed the scope of the 11-month study with Gray, they suggested assessing brain-to-brain coupling, or neuro-synchrony, between *Overwatch*-playing dyads from the 120 participants made up of half vets and half civilians.

The key questions: Are team players — whether two vets or two civilians with different experience levels — in sync; that is, literally on the same wavelength through neural synchrony — as they escort the payload to its destination? And if so, what specific aspect of

their communication leads to this bonding? The study also considers the difficulty level of the game and how the players’ proximity to each other, looking at both remote and in-person play, impact teamwork.

“Neurophysiological measures of the brain provide us with a unique new perspective on mental processes, and complement and expand up behavioral performance metrics,” Ayaz says. The researchers even got the gaming company that produces *Overwatch* to customize the game for their experiment by creating special tasks for the players that emphasize teamwork.

As Ayaz explains, he is most excited about using wearable brain and body sensors to assess team dynamics and simultaneously monitor multiple brains cooperating on the same game scenarios. The project combines both fNIRS and EDA to non-invasively gauge players’ mental efforts. fNIRS, or functional near-infrared spectroscopy, and wearable neuroimaging more broadly, is Ayaz’s bailiwick. While earning his graduate degrees at Drexel, he developed new neuroimaging methodologies and a novel brain-computer interface, and today his lab is a leader in investigating how the brain functions in workplace and everyday settings, which is part of a new field known as neuroergonomics. (Ayaz is one of the field chief editors for a new international journal called *Frontiers in Neuroergonomics*.)

“With wearable and mobile sensors, we can now monitor the brain activity in realistic settings and even outdoors or in the workplace, so you can do the task just like you would in the real world,” Ayaz says. “Here, we’re emulating the typical environments for gamers, and the groups of teams that they form, to measure multibrain and multimodal biosignals.”

One portion of the project is planned to take place at Nerd Street Gamers, a gaming venue in Philadelphia, where researchers will gather more data on teamwork and game dynamics during an actual *Overwatch* tournament.

“This,” Ayaz says, “is pushing the frontier.”

On a recent March afternoon inside the Behavioral Lab, a team of researchers that includes Ye sets up two gaming stations on opposite sides of the large room, each running *Overwatch*.

For the uninitiated, *Overwatch* is a cooperative, multi-player combat game set in a futuristic Earth that has been threatened by a robot uprising and dangerous political intrigue. Players are first-person “hero shooters” who collaborate with online strangers assigned to their team to restore order by completing tasks within a time limit — earning experience and “loot” along the way. Praised for its colorful, fluid worldscape and accessible gameplay, *Overwatch* became all the rage after its 2016 release by Blizzard Entertainment, earning \$1 billion in its first year and drawing as many as 30 million users globally, according to parent company Activision Blizzard.

**DATA\_OUTPUT**  
The fNIRS and EDA technology generate a dataset of objective information on players’ mental efforts.



**WEARABLE MONITOR NO. 1**  
While the study participant plays the video game, she wears a 1½-inch-wide gray band around her forehead — the fNIRS device. The headband monitors her brain activity as she moves through the game’s virtual universe, including how much oxygen she consumes.



**IN\_PLAY**  
In the *Overwatch* behavioral experiments, two players navigate their avatars to escort payloads to new destinations. Each participant first plays individually against an A.I. opponent, and then against each other, while biomedical devices record their body’s responses.

**WEARABLE MONITOR NO. 2**  
The study participant also wears an electrodermal activity (EDA) device around the index and middle fingers of her left hand, which collects information on her skin conductance to measure emotional arousal.

The game has figured mightily in international esports competitions with six-figure prize pools and professional teams, including the Philadelphia Fusion. Comcast is heavily involved; its unit Comcast Spectacor paid \$20 million to start the Fusion, one of 20 international city-based teams that compete in Blizzard's *Overwatch* League that launched in 2018. Along with the Cordish Companies, Comcast Spectacor also is building a \$50 million, 65,000-square-foot, 3,500-seat Fusion Arena in South Philadelphia, near Citizens Bank Park, that is scheduled to open in 2021. In addition, Comcast Spectacor is investing in Philadelphia's Nerd Street Gamers, which looks to develop additional esports competition facilities at college campuses and inside Five Below stores in the next few years. The Fusion franchise, next-gen arena and other investments are bold bets on Philadelphia as an esports destination and on the esports industry itself, projected to hit \$1.8 billion in 2022, according to analytics company Newzoo.

*Overwatch* proved the ideal choice of video game for the experiments, Gray says. "With our company's commitment to the military community and our Philadelphia Fusion competing in the *Overwatch* League," Gray says, "the choice is even more relevant to inform future business decisions."

In the *Overwatch* behavioral experiments, two players navigate their avatars to escort payloads to new destinations. Each participant first plays individually against an A.I. opponent, and then against each other, while biomedical devices record their body's responses.

As Ye defends against the enemy and nudges her payload along, she wears a 1½-inch-wide gray band around her forehead — the fNIRS device. The headband monitors her brain activity as she moves through the game's virtual universe, including how much oxygen she consumes. She also wears an electrodermal activity (EDA) device around the index and middle fingers of her left hand, which collects information on her skin conductance to measure emotional arousal.

This study breaks ground because it doesn't rely solely on subjective self-reporting of the experience, as is typical. The fNIRS and EDA technology generate a dataset of objective information on players' mental efforts.

Comcast will use the data and analysis provided by the DSI team to understand how teams of players, particularly veterans, bond and work together to succeed at the game.

"Serving military customers is a part of Comcast's military engagement value," says Gray. "We're excited to see how the study will inform how we create esports experiences tailored for military veteran gamers."



**SIDE FROM ITS VALUE** to external partners, the fledgling institute is having a significant influence on the University itself. Suri, the co-leader of DSI, thinks it is driving a sea change in Drexel's culture.

"We're in Philadelphia, in the middle of an industrial corridor," he says. "We need to engage industry in a way that makes the University more forward-looking. In the lab, we do inventions, but we have to translate that into innovation."

Ultimately, DSI projects create immersive, even global learning environments that "train students to be thought leaders," Suri says. "Research normally exists in isolation on campus. DSI is the medium to translate the internal to the external and vice versa, looking at what industry wants and bringing students along with us in a meaningful way, while also bringing industry into our research and classroom spaces."

"That," he says, "is path breaking."

Before the institute had a track record, it had difficulty recruiting students to join projects, says Suri. "Now, we don't," he says. "When they start working, they find it exciting and engaging."

No surprise there, considering the robustness of DSI's collaborations.

In one project that began October 2020, three co-ops and two marketing graduate students have been helping to run a feasibility analysis of a new program that supports clients of Options For All, which provides support services to adults with intellectual and developmental disabilities.

OFA faced a conundrum because it lacked expertise in how to provide enrichment opportunities, particularly during a pandemic, for its older clients who were aging out of the nonprofit's social services programs. "We were aware of the need for a senior program," says Brian Zotti, OFA's vice president and chief of staff. "Our own participants were saying,

'I can't keep up anymore.' But we just don't have that kind of bandwidth."

So, OFA President and CEO Ken Barnes, MBA '11, turned to his *alma mater* for suggestions on how to create virtual and in-person life skills programs for its clients. "The idea of harnessing the power of a top-tier research university to create a solution for our nonprofit," he says, "seemed like a can't-miss decision."

As Zotti put it: "Drexel brings the muscle of expertise."

The Drexel team was able to present OFA with a go-to-market plan that focused on virtual reality experiences and included an impressive demo of a digital tour of the Academy of Natural Sciences of Drexel University, which allows participants with VR goggles or a tablet to virtually stroll the museum's dinosaur exhibits and dioramas.

The result was a platform that OFA would never have envisioned, let alone developed, on its own.

"That's really the magic," Howley says, who was tapped by DSI to consult on the project as a faculty member. "DSI matches the needs of the project to the faculty." As the project developed, experts from the School of Education and College of Computing & Informatics suggested meaningful curricular activities and the VR demo.

"The clients love this," Howley says. "It's not out of a report. It's not something they read in an article. They're able to talk to the person who wrote the article, the expert in this."

Likewise, Philadelphia-based FMC has partnered with Drexel experts from the Dornsife School of Public Health and LeBow College of Business to study the health impact and community attitudes toward its clean water project in India. FMC is working with a cross-functional team of leaders from Drexel and an NGO named Community Pure Water, as well as a local research agency in India, to install reverse-osmosis water-filtration plants over several years. A focal point of the effort is to conduct community needs assessments and to collect and analyze health and socioeconomic conditions in targeted villages, with scientific and technical support and guidance from Drexel.

"Installing reverse-osmosis water systems is not overly complicated; however, you want to be able to measure impacts and understand if your investments are addressing the community's needs and positively impacting people's lives," says Shawn Whitman, FMC's vice president of government affairs. "If we want to know the actual impact and the return on investment in sustainability, we need experts who specialize in those spaces. This is where DSI brings real value."



RESEARCH NORMALLY EXISTS IN ISOLATION ON CAMPUS. DSI IS THE MEDIUM TO TRANSLATE THE INTERNAL TO THE EXTERNAL AND VICE VERSA, LOOKING AT WHAT INDUSTRY WANTS AND BRINGING STUDENTS ALONG WITH US IN A MEANINGFUL WAY, WHILE ALSO BRINGING INDUSTRY INTO DREXEL'S RESEARCH AND CLASSROOM SPACES.



**FROM ITS FOUNDING**, Drexel has sought to orient students outward to the world, and toward the future of work. In its recently completed 2020–2030 strategic plan, Drexel spotlights DSI as a template for how the University can actualize its model of maximum real-world relevance.

DSI's foremost mission, after all, is to build relationships that mutually benefit not only external partners, but also a wide swath of faculty and students. Besides offering students chances to solve practical problems, projects also lead to consulting-style research co-ops, résumé-building talking points, and in some cases, full-time employment offers after graduation.

The collaborations also, in turn, inform curricula. A corporate partner might visit classes as a guest speaker or even develop and teach a brand-new course on the latest market trends. Conversely, DSI might contract with a company to create a customized degree program or workforce training for its employees.

In one recent example, the institute expanded on its existing relationship with Malvern-based investment advisor Vanguard Group to create a 2019 course on "Blockchain in Capital Markets" that was jointly developed by John Evans, head of Vanguard's blockchain strategy, and the Pennoni Honors College. In the final class deliverable, groups of students analyzed the impact of blockchain technology on different stakeholders: an issuer of securities, an investor, a bank, a regulator and a technology provider.

"The opportunity to put this subject in front of really bright honors students was really appealing," says Evans, who co-taught the course with an interdisciplinary team of Drexel faculty members who each covered a different aspect of the financial, sociological, engineering and legal aspects of blockchain.

"I put myself in the shoes of the students," Evans says. "It would be really valuable to get perspective from a company like Vanguard in such a nascent space that has such a potential impact, and to get a window into how this was being thought about in real time."

For students, a DSI-managed project provides a rich experience that weaves together teamwork, problem-based learning and career exploration into one. Projects such as the Comcast esports study offer a chance to work on interdisciplinary teams and see a concept through, from inception to final deliverable. "There's ownership," Koulas says. "Students get to learn more about the ins and outs of an organization, and what their products and services are going to look like in the future."

For Ye, her work with industry clients at Drexel has already paid a big dividend: When she graduates in June, she has a job awaiting her as a marketing assistant professor at Clarkson University in Potsdam, New York.

"In my conversations with interviewers," Ye says, "what caught their attention was my experience with DSI." Besides Comcast, she also worked with PECO and Lavazza, among other organizations, and developed and co-taught an undergraduate course called "Research with Industry."

"A lot of the schools I interviewed with expressed interest in having a center like DSI," she says.