Just Understanding Human Responses to IED Attacks

Intro [00:00:01] RTI International's Justice Practice Area presents Just Science.

Intro [00:00:09] Welcome to Just Science, a podcast for justice professionals and anyone interested in learning more about forensic science, innovative technology, current research and actionable strategies to improve the criminal justice system. In episode four of our Domestic Radicalization season, Just Science sat down with Dr. William Parkin, senior research analyst at RTI International, and Dr. Rainer Hilscher, senior research data scientist at RTI International, to discuss what people do when an improvised explosive device or IED detonates in a public space. When IED unexpectedly explodes in a crowded space, people can react in many ways, including freezing, fleeing, helping, or hiding. Using information from past attacks, researchers can predict the way people will behave after an explosion, which informs the way first responders are trained for these events. Listen along is Dr. Parkin, and Dr. Hilscher described what they learned from case studies like the Boston Marathon bombing, how they use software to model human decision making during a crisis, and the unique challenges of conducting this kind of research. This episode is funded by RTI International's Justice Practice Area. Some content in this podcast may be considered sensitive and may evoke emotional responses, or may not be appropriate for younger audiences. Here's your host, Michael Planty.

Michael Planty [00:01:17] Hello and welcome to Just Science. I'm your host, Mike Planty, with the Justice Practice Area at RTI International. Our topic today is focused on human behavioral responses after a targeted IED attack. IEDs are improvised explosive devices, which are homemade bombs or destructive devices. IED based terrorist attacks pose a persistent threat to the United States and are particularly acute for soft target. Soft targets are open public spaces that can attract large number of people. Think of schools, train stations, stadiums, parks and shopping recreational areas. To a terrorist soft targets represent an opportunity to stoke public fear and cause mass casualties. Despite the bombing threat to soft targets, relatively little is known about individual and group responses following an IED attack. Information is needed for bombing prevention and response procedures to account for the real life behaviors that civilians and emergency personnel demonstrate immediately following attack. Today, we're excited to speak with Dr. William Parkin and Dr. Rainer Hilscher, two experts on understanding human responses to IED attacks. Welcome to the podcast.

William Parkin [00:02:18] Hi, Mike.

Rainer Hilscher [00:02:18] Hello, this is Rainer.

Michael Planty [00:02:20] Dr. William Parkin is a senior research analyst in the Security and Extremism Research program at RTI International. His research interests include terrorism, domestic extremism, climate change and domestic security issues, and utilizing agent based modeling to examine violent targeted attacks. Dr. Rainer Hilscher is a senior research data scientist and principal investigator at the Center of Data Science and Artificial Intelligence at RTI International. His research interests include utilizing agent based modeling to examine violent targeted attacks and simulating modeling of chronic diseases in social determinants of health. To kick us off today, Will tell us about what led you and your team to focus on this issue we're trying to understand today in terms of human behavior in response to targeted IED attacks.

William Parkin [00:02:59] So we're working on this project with DHS's Office of Science and Technology Directorate and also the Office for Bomb Prevention, which is part of CISA, another organization under Homeland Security. And they came to us asking to actually answer a pretty simple question, which is, what do people do after an IED function? So after it detonates, there's not a lot of research on it. Fortunately, in the United States, this is a pretty rare event. The Office for Bombing Prevention does multiple trainings throughout the year, and they reach thousands of people. And during those trainings, they have people come up and ask them, what can we expect as a first responder? What could we expect as a civilian for to happen if an IED actually functions? And how could we prepare for that? So the research question is basically that, and from that we decided what is the best way to get at this answer?

Michael Planty [00:03:48] Rainer, what is your interest in this topic?

Rainer Hilscher [00:03:49] I've been doing simulation modeling ever since I completed my PhD, and so far at RTI, I've been doing a lot of micro simulations. And these types of simulations we're talking about individuals and microsimulation I've been doing, we updating them at every time step, fixed set of attributes, modeling mostly equation driven. All these individuals are independent. There's no interaction with environment and there's no decision making. For this project now, this is completely different because we actually talking about modeling a complex social situation where modeling is much more conceptual. So abstracting from reality than with the micro simulation. And from my experience, abstracting from reality is the least appreciated aspect of modeling fraud. So SMEs, statisticians, software engineers, they get a lot of credit easily. They seem to be doing all the work. But this abstracting from reality is so important. And this is what grabbed me about this project, because it is a very complex situation where individuals, they do make decisions, they do interact with each other, and they do interact with the environment. Now I finally get to do that.

Michael Planty [00:04:51] That's great. And, you know, and that's what really excited me about when I first approached this topic is how we were taking real situations, extracting that information from it, and then using these other techniques to really simulate, because random controlled trial in this space is really, not applicable. The type of methodology you can use to really understand these behaviors, you have to be really innovative and kind of leverage these types of things. Let's just first describe the problem of IED bombings, soft targets and individual and group response. What are the targets? What is an IED? Some basics there.

William Parkin [00:05:22] When we're talking about this, especially for the project that we're working on, we're not thinking of IEDs in a military zone or military grade weaponry. We're thinking about terrorist attacks at public targets in the United States or abroad. And so what we're concerned with and what we're trying to think about is when these events do occur, how does the public how do first responders act immediately after it? And we're specifically interested in, you know, Rainer talked about modeling. We're interested in modeling those first 3 to 5 minutes after an attack occurs to see what people are doing, because then that can help us inform and provide hopefully actionable insights to first responders to know how to approach a site, what they should expect when they're approaching a bomb site after an IED functions. And so, you know, as you talked about at the beginning, you know, an IED, an improvised explosive device is basically an explosion, an incendiary device that is not used for some type of military purpose. Right. So it's something that is out being used out in the public to cause harm, to harm civilians. What we're specifically looking at, at soft targets in crowded places. So these would be locations

like hospitals, houses of worship, public parks or places where the general public will congregate. And there's not a lot of protection from law enforcement or military, so completely different from when we think of hardened targets like military bases. And so when we started the project, we had to really think about how we're going to create boundaries around what we're doing and what we're looking at. And so keeping with the soft target in crowded places, which is something that Homeland Security is very interested in protecting, and then also looking specifically at IEDs because of Office for Bombing Prevention's interest.

Michael Planty [00:06:56] So we're thinking about things like an IED is it typical like a pipe bomb? Someone put something in a package or actually now, you know, there's a whole thread about autonomous vehicles loading up with explosives and parking in front of a building or some other, you know, location.

William Parkin [00:07:09] Yeah, exactly. The Office for Bombing Prevention actually tracks the number of events that occur in the United States specifically, and then they publish that to their website. And there's a lot more goes on in the United States than really makes the news. A lot of it is people building IEDs. And so law enforcement is able to identify that and stop it before an event occurs. But there's also a lot of functioning of things like pipe bombs. So we'll talk a little bit about how we did get information about different cases. And for those cases we used more high profile terrorist events. But there is a lot of activity that occurs in the United States that is not high profile. No one's killed, maybe somebody is injured or there's property damage, but it doesn't make it into the news, or at least the national news.

Michael Planty [00:07:49] And also with the IED, there's this complication there of a single bomb versus multiple explosive devices. Right. So you set one off, people respond, and they anticipate how people are going to respond. And it causes even more mass casualties because of that dual response. And then also the variability you described in terms of a hospital, place of worship versus an open park, that might go into some complex modeling that Rainer is dealing with in terms of if you're within a stadium, say, versus within an open park system, very different types of variability in terms of trying to capture how people would respond. So those are really interesting facets, right, to how you're you're eventually going to understand response.

Rainer Hilscher [00:08:25] That is actually something really interesting that we learned when we did our research and visited different sites. A single explosion will make people confused, and yes, they will react, but they might not run because they don't know what's happening. But the moment you have a second or third explosion, those additional triggers that will set off people and they then will start panicking, they then will start evacuating. But it takes that second or third trigger.

Michael Planty [00:08:48] So your research is really focused on understanding how people behave in the seconds, in minutes, following an explosion. What is the concern and need to understand individual and group responses following an explosion?

William Parkin [00:08:58] We approach that from multiple perspectives, and I think that also gets towards kind of the insights that we have, at least for the case study reports that we did. And that's at different levels people have different concerns. So you're an individual, you're in a public place and there's an explosion. You're probably concerned for your safety. If you're with a family or friends, you know, you're concerned with the safety of them also. And that's going to vary differently from law enforcement, whose primary

concern might be to immediately go to the site where the explosion occurred. It might be to render aid to individuals who are injured. It would be good to talk about, one real case example that we that we've looked at, which is the Boston bombing and the, you know, the Boston Marathon bombing, where there were two IEDs detonated in a terrorist attack. In that example, we actually have good footage of the finish line. So we see how people react. And this gets to kind of our methodology for trying to calibrate and build the modeling to make sure that there's some validity and reliability, you know, for how people react and how the modeling is occurring. And with the Boston bombing, we have video of the finish line. So we see the moment that the IED detonates, we see how people respond immediately to that. We also see when the second explosion occurs, how everybody reacts after that. So as Rainer talked about and you talked about with the secondary explosion, there is evidence that with the Boston Marathon bombing, they purposely had spread the IEDs and the timing across, basically, it's about a block and a half between each other. And with the idea that people might be pushed into where the second IED functioned. But what we see is in that first explosion, you have that immediate flinch, right? You're immediately moving away from the danger. You actually see law enforcement immediately moving towards the explosion. And, you know, part of that we put into the modeling, based on the training of first responders and some assumptions that we make on how they will react. And then you also have a lot of people who are just standing around and they watch. So for those 10 to 15 seconds between the two explosions, people are just standing and watching. And then it's really that second explosion. Like Rainer talked about. It creates an understanding that you're going from, was this an accident? We're not sure what's going on. We see that people are hurt. There's probably some type of danger, too. We now know that this was purposeful. We now know that there is the likelihood of continuing danger, and then everybody starts to flee after that. And because we have the video for that, actually in multiple places along the street where the explosions occurred, we can start using real world information to start modeling and determining how we think our models should look. They run them even when we drop them into different environments.

Michael Planty [00:11:23] Just to center the listeners again. Once you understand these things, you have a better understanding how to inform trainings and how to inform preparation for sites. So if something does happen, as you mentioned, it's just not how bystanders react, but it's how first responders respond. Can you give us a couple more examples, concrete examples of we talked about the Boston Marathon. Are there other ones that show the variability of what you're trying to understand?

William Parkin [00:11:43] We looked at the Atlanta Centennial Olympic Park bombing, which occurred in 1996 during the Olympics in Atlanta. We looked at the Madrid bombings in 2004, and this was against their commuter train system in Madrid and then London, bombings in the underground and actually on a bus in 2005, Brussels airport and train bombing in 2016, and then the Manchester Arena bombing in 2017. So we looked at this wide range of events, and our approach was to collect as much information as we could about these attacks. We're able to start pull together some understanding of how people are acting around an explosion and being able to kind of calibrate over time and distance how those behaviors change. So we can look at over that 3 minutes or 5 minutes right up against the explosion, maybe a block away. How are people reacting and how do those reactions differ. And then using that information to inform the modeling that we're doing. And I mean, these are all different events, but we do end up finding a lot of similarities in human behaviors at these events so.

Michael Planty [00:12:45] You did touch on this earlier in terms of what are those major responses people have. At the individual level, you have things like freezing, fleeing, helping leadership.

William Parkin [00:12:54] Yeah. So when we approached it, the case studies, we tried to start with like a blank slate. What are we getting from this information that we're collecting? What types of behaviors are we seeing. And then can we put those into the modeling? Probably the most prevalent thing is freezing that we've read about and seen. People then will transition to fleeing, trying to get away. We also see people engage in leadership roles and then the helping behavior. There's a lot of reporting on the helping behavior within the open source that we look at. They're really impactful, I think, on what occurs because a force multiplier with first responders, they're there till paramedics can show up and then they can assist paramedics or law enforcement once they get there.

Rainer Hilscher [00:13:28] The way we model behavior in time and space so that for example in space we have these concentric zones. So you have the explosion. And then depending on how far away you are from the explosion, your behavior is different. And also depending on how long the explosion is in the past, you act differently. The way we we model behavior in time and space, this is really one of the most innovative aspect of this project. Previous research, they did have phases, but they were much longer. But no one has really looked at these first couple of minutes, seconds after an explosion.

Michael Planty [00:13:59] This really sets the stage of these individual behaviors, the context of the the magnitude and distance of where people are and then the social conditions. Right. Are you in a stadium? Are you in a street open space?

William Parkin [00:14:10] There definitely is a difference in reactions from people, whether or not you're in a location, or maybe there's a known threat or attacks have occurred before. People already primed in those locations to know that is something occurs to think back to that last event and immediately respond after that first part of the attack. Compared to locations like the Boston bombing, where there had not been an event before, the behavior definitely does vary based on the environment. And I also think the history of the environment that you're in.

Michael Planty [00:14:37] And the more that media covers these events, the more that people might be, hey, situationally aware, and you have these false alarms potentially, that could trigger these things. So to better understand how people respond during these IED attacks, you were using this technique called agent based modeling, or ABM. Rainer, let's walk our listeners through this approach and what you're seeing with these modeling techniques.

Rainer Hilscher [00:14:59] Agent based modeling is actually the most complex tool in our modeling toolbox. So at RTI, we use a wide variety of modeling approaches and agent based modeling is by far the most complex one. So in a nutshell, that's a bottom up simulation approach where we study complex social systems with explicit agent agent environment interactions. So when one agent does something, another agent reacts to it. If there's a wall, people react to it. They cannot run into a wall. If there's a door, they can walk through the door. Agents also make explicit decisions. So in most other simulation that I do, we have just simply updating of characteristics. But there is no decision making. So that makes it much more interesting. And finally the way we build this model has different requirements. And we used a software package. Any logic that already provided us with a validated pedestrian model, meaning they have a system where people actually

walk along walls. So you can define a path and people take that path. And also it lets us very easily simulate a physical environment. All other models we have, we don't care about the environment. Here we actually need to model environments with walls and doors and streets. So that's agent based modeling in a nutshell. In our case now we have a fairly complex decision module. Still we had to abstract a lot, but it's complex. Basically there are two components to it. And one is that individuals move the system calculates a certain path, an individual will follow that path, but then their behaviors that will end. And you talked about freezing, fleeing, helping, being vigilant or hiding. So when people evacuate, these behaviors might disrupt their movement. They stop and they help or they stop and freeze. And the way we've modeled these two different components by using for the movement, so-called social force model, so that I think was developed in 1999 and it's been used in myriad of different research papers. The software package we have, and especially this pedestrian model, has the social force model already implemented, which was very good for us because it's been validated, it's implemented so we don't have to worry about testing it, making sure that it actually produces what we think it does. So one source of error was gone by using that. So what does the social force model basically do? It combines psychological and physical force. When people move they have a desired speed. There is a force between individuals. So you don't want to bump into other people and you try to avoid them. But there's a the optimal distance to which you can get to individuals. There's also a force between individual and walls or any obstacles. So you try to avoid those. When you see an opening you can walk through.

Michael Planty [00:17:34] In your modeling, what are the biggest factors that you bury? Is it the number of people in the space? What are the bigger factors that you're really trying to understand in terms of the output here?

Rainer Hilscher [00:17:43] What we really trying to understand is, are these patterns. So when ants walk around and they drop their pheromones and suddenly you see these paths because more and more pheromones were dropped, it's called stigmergic decision making. So more and more ants pick up these pheromones and suddenly you see these paths emerge. Same is happening here. As people walk, we see okay, so there is a point where people are queuing up. So we need to be careful here or there are too many people in this area. So we need to open up a second area so that we get two streams. So it's really these emerging patterns that we see over time and they will help us maybe how to redirect or where we need to make sure that, yeah, we open up or we close something off. So that's one aspect. The other one of course, is totally dependent on the environment. So is it an indoor environment? Is it an outdoor environment? The number of people. Yes, that's very important. But there's actually a lower limit where we already see these patterns emerge. That's something that we empirically figure out. How many people do we actually need to already make meaningful predictions?

Michael Planty [00:18:44] You're picking up these natural patterns that people develop right immediately after. Are you also trying to, examine the number of potential casualties that could occur within these spaces based on these variables?

William Parkin [00:18:54] Like Rainer was saying we want to see emergent patterns, right? So we're trying not to say this percentage of people is going to engage in helping or this percentage of people is going to flee. But there are some things that we actually, we do put metrics in that are defined, like with an IED, depending on the size of the IED, we will say, if you're within a certain radius of the IED, you have this percentage of being a casualty. And so we can vary that. And so we could change population density. We can change that radius based on the size of the IED. And then we'll see variations in the

number of people injured and or killed. And then we can see how that then impacts the flow of the crowd. It impacts how many helpers show up, how many people flee, how many people freeze. There are things that we allow to vary on their own so that we can see how those natural behaviors emerge. And then there's other things that we control a little bit more, like the size of the explosion radius and the percentage of the likelihood that you'll be injured.

Rainer Hilscher [00:19:43] One other very, important aspect of the model on top of injuries, we can set the range and explosion has an effect where people get injured or killed. But also we have a setting for fear, and that is, people are not injured physically, but they do recognize, okay, something happened and they react to it. And we in the model, we can set it to a very close. So when we do, for example indoor space, we can set it fairly narrow area. Whereas outdoors, we set it to a very wide distance so that people, even that are far away from the explosion still show in reaction.

Michael Planty [00:20:15] I mean, this raises a question for me in terms of, if I'm a practitioner, right, a local law enforcement, say, or somebody at the federal level and saying, okay, we're going to host this event with 100,000 people at the stadium, you know, could you simulate situations that are very specific to soft targets, if you will?

William Parkin [00:20:30] So we can do that. And actually, as part of the study, we have multiple site partners that we work with where we are doing that. I think the power behind that is one, yeah, you can give individual sites and locations and first responders an idea of what should occur within that environment, because, you know, we can give the general patterns and we'll talk about the general patterns in our reports. But that's a little bit different than seeing all right, here's an entrance. Or here's some type of physical structure in your environment that people get stuck around or it causes. Because we also in the modeling we look at crush behaviors. So if crush behaviors occur, the modeling should show that, you know, if people are getting trampled or if people are getting stuck and can't move through a location like a bridge or a tunnel or something like that, we can show all that for location specific modeling.

Rainer Hilscher [00:21:17] From a modeling perspective, there was another requirement that the decision module that we developed is independent of any environment that we place it in, meaning we can model all these different scenarios that you just laid out. The important thing is that, A, we have the physical environment that we can model. So a stadium of course looks different from Boston, so a city and urban area. We need to be able to model the physical environment. And that software package we're using, you can even load in a blueprint and you get the physical environment. But the key is that the decision module that that we implemented can handle that. We don't have to change any code. We have to change certain variables, certain values to adapt it from an indoors to an outdoors. But the power of this model is really that just by changing the environment, we can study a completely different scenario.

Michael Planty [00:22:03] With this research, what are the biggest challenges that you face in terms of the potential limitations that you're up against? You have the case study and you have the agent based modeling.

Rainer Hilscher [00:22:12] It is very complex, and we have to make a lot of simplifying assumptions. And just to come back to finish the decision making, but that's actually a simplifying assumption. On top of the social force model, we have all these behaviors to select from. And we're using something called the agent zero framework. It sounds very

fancy, but actually it's the way we've implemented. That's one of the limitations straightforward. So basically there's an effective disposition irrational antisocial and the effective basically emotional rational. Yeah. You start thinking about your actions. And social is what you look at what other people do. We totally aware of the fact that we using rational in a very common way. So not in the more scientific way, but it's what makes most sense when we talk about this model, by looking at the emotional, the rational, and social disposition, we just add and we have certain values and there's a threshold. It's powerful, it's working, but it's also a simplifying assumption. So that is already a limitation that we are aware of, but no one else has done that before. So this is already very innovative. And of course we would like to have it more complex. The other one of course is the scale. So if we really scale it up to 50 100,000 agents making these complex decisions, that's computationally very intensive. So that's another limitation where we have bigger machines in the cloud, then we could run larger simulations. But because of the complexity of decision making, that's really a limitation.

William Parkin [00:23:30] One of the biggest limitations is just the lack of data to inform the model. I mean, that's great, right? That we don't have hundreds of IED events that are captured on video and people being injured or killed, but that does make it difficult with the modeling component of it. We are able to say, you know, this is valid, reliable human behavior patterns that we see. So when we run the models, we can think back to all the videos that we've watched and say, all right, we've seen this here. So this seems like a good modeling outcome. Or we can say, hey, something's happening in the model that's never occurred, that we've seen a video. That doesn't mean that it wouldn't occur. It just means that we don't have the data or the information to validate it. And so we have to struggle with that and work through that. And I think that the methodology that we've come up with fairly good, and I think we've done a really good job of making sure that our models are showing what they probably would show in real life.

Rainer Hilscher [00:24:20] So far, the behaviors that we have, as complex as they are already, especially for the different types of agents we have in our model. So, for example, individuals or law enforcement officers. So far they fairly scripted that we have certain values and could set to this, to this, or that would we would love to see is that they actually react to each other in a more evolving way, so that strategies might actually evolve that we didn't think of. That's a limitation. Not to say that other people have done that. No. No one has done the kind of work that we've done. But that would be a very cool direction that we would like to take this kind of research.

Michael Planty [00:24:54] So that's a really interesting thing, right? Modeling behavior, but it's not ideal behavior. We wish these people wouldn't have froze their or they should have egressed out of this place, not over here. That's a complication in terms of ideal versus the real nature of human behavior.

William Parkin [00:25:08] Yeah, Mike. And I think that ties into, you know, future research that we really are looking to get into modeling law enforcement responses. That's modeling different types of training. If you think about active shooters at schools, how would you model, you know, ALICE training or run, hide, fight. So putting into the models, if you go through this training this is what you should do. Now, how does the outcome then change? If you put in this other type of training, you know, for law enforcement, if SWAT shows up and does X, what happens if they show up and do Y? Are the outcomes different? And so for future research because agent based modeling is a extremely powerful tool. And so it actually would allow us to do these types of things where we can model not only what the crowd is doing, but also, you know, if they do something different, like you're saying, how

does that change the outcomes? Are people safer than law enforcement or first responders do different things? How does that change the outcomes? And so being able to inform training for that, I think is definitely a great next step for this.

Michael Planty [00:26:02] Even space and time thinking about first responders, how quickly are they at the scene? Right. If you're prepared and they're at the scene and they're prepared at certain places where they could facilitate optimal crowd arrangement or dispersement, that's really an interesting factor you can really explore.

William Parkin [00:26:17] Exactly, if you're a law enforcement officer or a paramedic and you're showing up 30s after an IED detonates, it's going to look much different than if you show up three minutes after things have pretty much calmed down. If there was only one IED, and you could probably get to the blast site a lot quicker and a lot safer, as opposed to showing up at 30s. So yeah, all that stuff can be modeled.

Michael Planty [00:26:36] I mean when you're in these situations, you know, seconds matter. So what are these emerging threats? I mean, you mentioned a couple of other applications, soft targets that are emerging or even the response, you know, you see, in terms of school shootings, a lot more target hardening happening, right? Where is the future taking you with this type of work?

William Parkin [00:26:52] Something that we're doing now and we actually will be doing in the future. And that's incorporating protective measures. So as the threat landscape changes, how might law enforcement, how might schools or you know, entertainment venues adapt to make sure that that they're protecting the people who are there and we actually are building those into the models. So what happens if X number of doors are locked and people can't get in or get out? What happens if you open up this pathway and close this pathway? So those protective measures were definitely put in. And also you know you talk about the IEDs that can be modeled. Also, so the location of the explosion. So right now we're modeling IED locations based on what security and law enforcement think would probably be the most likely placement for the types of attacks that we're looking at. But if you bring in drones, you know, that definitely expands the area of where people can get past security and injure people.

Rainer Hilscher [00:27:43] So what you just mentioned, the hardening, actually adds a morbid aspect to our modeling, because when we look at these simulations and we plan them out, we actually have to simulate in our heads what might happen or where to place an IED. Especially you mentioned hardening. So now it's no longer oh, that's where most people are so let's just plant it there. No, wait a second. It's hardened. So where is the location that's most easily accessible from an outside perspective? That is actually the first step where modeling comes in that that we have to simulate in our heads what might happen, where might it happen. And then we need to start actually turning it into a conceptual model and then into code.

Michael Planty [00:28:22] I mean, that is a really excellent point. I don't think I really highlighted here with these questions in terms of offender behavior. They're not just randomly doing stuff, right. They're being strategic in many ways and saying, this is where we can get the most casualty or instill the most fear. So you have to have that mentality too. So really, really interesting.

Rainer Hilscher [00:28:39] You're absolutely right. But it's also the most to some extent unfortunate aspect of this because it's really interesting as it is this from a research

perspective, you're still talking about casualties and you have to simulate that. So and especially, Will, who went through a lot of these case studies that wasn't pleasant viewing.

Michael Planty [00:28:55] No, no. It's a real and devastating event and really exciting research you're doing. I want to thank our guests. Will Parkin and Rainer Hilscher for the excellent conversation. Really informative. Thank you so much for your time and sitting down with Just Science to discuss human behavior responses after a targeted IED attack on soft targets and crowded spaces in our efforts to better understand these complex situations.

Rainer Hilscher [00:29:17] Thank you Mike.

William Parkin [00:29:18] Thank you for having us, Mike.

Michael Planty [00:29:19] Also, thank you, the listener, for tuning in today. If you enjoyed today's conversation, be sure to like and follow Just Science on your podcast platform of choice. I'm Mike Planty and this has been another episode of Just Science.

Outro [00:29:31] This episode concludes our domestic radicalization season. Tune in next season to learn more about recent innovations in correctional facilities across the country. Opinions or points of views expressed in this podcast, represent a consensus of the authors, and do not necessarily represent the official position or policies of its funding.