# E.O.D. + A.I.

## WORKING WITH ROBOTS

**How EOD personnel work with robots tells us a lot about teamwork with AI**

What can listening to EOD personnel talk about their work with robots tell us about the future of UXO RSP work in military and civilian settings? According to Dr. Julie Carpenter, these everyday details help scientists work toward ways of keeping soldiers and civilians safer when they work with AI.

**IABTI: You've been talking with soldiers about their robots and studying their interactions and attachments for years. How have they responded to a curious Ph.D. social scientist in their midst?**

*CARPENTER:* I feel fortunate that all the soldiers who participated in my research were very generous, sharing their time, expertise, and stories about their experiences. I even ended up including comments from additional EOD outside the formal study protocol at the end of my book, too, from soldiers who contacted me after the research was conducted to say they heard about my work from colleagues or in the news, and wanted to share how the research premise connected with their own experiences. There have been a few outliers, too, people who for whatever reason feel that the idea of exploring soldier interactions with robots is not critical or necessary, or doesn't apply to EOD or the military, at large. But for the most part, the military network--and the EOD community specifically-- has been very supportive of this research.

When people speak with me one-on-one, I think they get an understanding of my authentic desire to find out more about their experiences. Ultimately, I want to help soldiers to accomplish their missions as safely and effectively as possible, so we clearly have common goals. I've been incredibly grateful for the way EOD were supportive of the initial research. Since that work was not part of any military-funded research and was outside that system, it certainly could have gone another way at many steps, and been sidelined completely.

To conduct an academic study with people at all, you must go through a very rigorous vetting process within the university system to ensure your research methods adhere with certain standards for participants' mental and physical care. Like the military, academia has a lot of checks and balances and paperwork. So, I didn't just wander onto a military installment and start asking questions. In fact, often the people who spoke with me were EOD techs who were referred by other EOD techs. That sort of support for the research snowballed, which was great—in fact, that spontaneous type of study participant recruitment process in research is sometimes called the "snowball" recruitment method, and it wouldn't have worked out that way unless they each felt comfortable speaking with me, so that sort of personal endorsement was priceless.

This research was completely dependent on soldiers' voices, so their participation was critical. Recruiting enough participants for the study design was already problematic just because I was outside the system, but also because there are so few EOD relative to other jobs within the military - or Mission of Service (MOS) - EOD helping me get research volunteers certainly expedited the recruitment process.

**IABTI: Will you describe how you carried out your research (interviews, observations, etc.) and what your goals were?**

*CARPENTER:* My personal goal has always been to learn about soldier experiences and hopefully somehow contribute work that can help keep them safe, even in some small way, a piece of a puzzle. At the time, no one had looked at soldier interactions with robots in this way to investigate what sort of human-robot interactions were happening from a sociocultural lens. There's a history of human factors research in the military, but often more on the engineering side, such as ergonomics. But there is an entire interdisciplinary field of research called human-robot interaction (HRI), and in HRI we're learning people interact with robots in all sorts of ways beyond what you might expect of a human-machine interaction in any given context, and what causes it extends deeply into the cultural systems of people. And in a situation like EOD work, you certainly don't want any surprises from working with such a critical tool as a robot.

The actual methods of data collection and analysis were rigorous. I think there is a common misconception about the analysis of what's sometimes called "narrative" data, or in this case, people's spoken experiences. I laid out the analysis process in detail in the book, and that's something usually overlooked in popular media coverage of this work, where they are understandably more focused on reporting the research results.

The materials I used to gather the narrative data were a combination of things. I asked each soldier to complete a questionnaire, mostly for basic demographic information, and then I had a one-on-one interview with each soldier. Everything we talked about in those one-on-one interviews was audio recorded, then transcribed, and that's the narrative data. The data from the questionnaire and my field notes were also combined with each transcription into a sort of dossier for a fuller picture of each solider as an individual. Then we began the data analysis process to find patterns across the data set, which is incredibly rigorous, with multiple ways of checking validity of the results. I wish it was as simple as people picture it, where I pick participant responses I find interesting!

Because I was aware there really wasn't a body of existing research in this area, I also knew it could potentially serve as a sort of historical record, as social science work often does, and in that way it was significant, too. Therefore, I wanted to address any critical concerns in future reviews of this research, and I went above and beyond in terms of rigor in the analysis process. Every check and balance we could feasibly incorporate was used throughout.

Another significant aspect of this work was situating the findings from the narrative data into a larger cultural military framework, which is an approach typically used in sociological or anthropological research. The soldiers' stories were important, but there are other pieces of the larger puzzle about what influences their expectations about people and technology, and their beliefs and understandings about technology in general, not just the EOD robots. Culturally situating the findings involved my conducting years of additional research, including more interviews with military personnel and FOIA requests for less easily accessed

information about military robots and other aspects of military work, among other things. Then I had to connect the dots, if there were any to be found.

Ultimately, my goal was to discover what was happening, and report those observations accurately. I feel like I did that, with the helpful participation of the EOD who spoke with me. Mission accomplished!

**IABTI: What have you learned about the relationships EOD technicians have with their robots?**

*CARPENTER:* Keep in mind, this kind of exploratory research is about discovery, so my larger goal was to write a very rich description of the EOD-robot interactions that are happening, identify what factors (might) be causing certain interaction behaviors, and share that information outside the EOD world as well as with those directly involved. One thing the research revealed is that EOD have a distinct framework of beliefs, values, and communication strategies they apply to their human-human interactions with teammates, and I describe the different elements in detail in the book.

As for the robots, we know EOD personnel are highly trained, and there is no doubt they understand a robot is mechanical and they consciously categorize it as a "tool" and a machine. There were also patterns of social interaction with robots that sometimes included what we call an "extension of self," or viewing the robot as a physical and psychological extension of the operator over geographical space. Think of the robot like a video game avatar for the operator; but instead of an avatar a game player uses to interact with a virtual world, in EOD an operator uses the robot to explore and interact with the physical world, the robot acts for them at a distance. It's a similar concept.

It's also possible that the tendency to interact with the robots in social ways has a soldier age influence that informs inclinations or receptiveness for social categorization of a robot, but I cannot confirm that without further research and a larger sample size.

One thing I was concerned about when I began was if there were social ways of treating a robot, as had been reported in the news, were any of those social behaviors or emotional attachments toward a robot in any way affecting decision-making when they work with one? The answer is that I don't believe it does, currently. However, I say "currently" because the interactions and attachment styles will change when some of the variables change, like team size, the average age of EOD personnel in a team, EOD folks who come in to the job with different exposure to robots as robots become more commonplace in society at large, and the robot's design. Certainly, the military is moving towards robots that have some animal-like or humanlike qualities because in some situations, those characteristics are helpful. For example, having teleoperated humanlike hand attachments on an EOD robot may be more effective for rendering safe some UXO. Having two or four legs on a robot, as opposed to tank-like tracks, may make it more agile and balanced across a variety of terrains. Or, a robot that can understand and respond to human speech can simplify operations in some scenarios. Each one of these design factors changes the user's perceptions about the robot's abilities, short-term. Long-term, it can potentially affect behaviors like socialness or human attachment, and those points are where things can get problematic in terms of potential distraction from tasks at hand, or otherwise influence human decision-making.

I believe all of the EOD people I spoke with for the initial study had ways of interacting with robots that I would very much characterize as normal, in that they sometimes treated the robot like a tool, an extension of self, or as a social "other." Depending on the use context, social interactions with robots—even very machinelike-appearing robots, like bomb disposal robots typically are—is emerging as a normal pattern of human behavior in many situations, and this research helped to substantiate that finding.

Another thing that exploratory research like this can do is pinpoint what parts of user experience might influence these behaviors, like training, or the robot design. Those factors can be tweaked to foster positive or mitigate negative attachment and related behaviors of the user. Furthermore, the findings from this research can also be applied to similar non-EOD situations, like civilian police personnel and programs that work with bomb disposal robots.

**IABTI: What stories or observations have particularly stayed with you?**

*CARPENTER:* Often the stories that stayed with me had nothing to do with robots specifically, but were very much about the nature of the people and the MOS, and very important for me to hear. But, all the details people told me — whether it was about their boredom from waiting days for a call to investigate a "just doesn't look right" situation that turned out to be nothing, or describing an actual RSP incident — were essential for me to listen to so I could get a fuller and more accurate picture of everyday situations EOD personnel face, in their own words. There were many stories that were grisly, but also stories about daily activities like paperwork and report-writing, too, and all of that was interesting to me because when I spoke with them I had the opportunity to ask questions and in that way, learn more about their very personal and individual experiences from before they were EOD through retirement, in some cases. I also learned a great deal about the forensic work that happens after an incident.

Part of what I walked away understanding was that every incident is unique, and that EOD work is far-reaching and extends way beyond what is commonly understood as the parameters of the MOS. I knew that intellectually going in, but I have a deeper understanding of how their work is relied upon in so many situations, domestically and abroad, situations a lot of people might not relate to them when they think of "EOD," but very much falls under their purview.

Additionally, training, ongoing training, and personal experience and subjective knowledge are critical for EOD personnel. Effective teamwork among EOD team members — as well as effective human-robot cooperation — can absolutely mean life or death, and successful communication between team members is critical, whether that is among soldiers or human-robot communication. People who are EOD are very good at compartmentalizing negative stress so they can focus on the task at hand, which is a survival mechanism that works well short-term. Long-term, of course, compartmentalizing negative stress can potentially have

some ill effects, like contribute to PTSD — which is nothing I diagnosed myself in the people I spoke with, but some soldiers self-reported to me.

On a side note, I learned in the research process that EOD personnel are generally great verbal communicators and often have an amazing sense of humor, too. Excellent verbal communication skills are also critical to this MOS, and it certainly worked out to be in my favor, since I asked them to talk with me.

**IABTI: Has your research with EOD technicians and their robots come to a conclusion with your recent book? Are you still working in that arena or do you have any plans to do so in the future?**

*CARPENTER:* I would love to continue military research. Unfortunately, I have yet to find the research funding opportunity that will support me continuing those military research situations right now. I feel strongly that applied research in this area of human-robot interaction is necessary to keep soldiers safer. There is a tradition of similar military research in human-computer or human-tool interaction that has been funded, and we understand the importance of people interacting with tools, whether they are rifles, tanks, or planes. But we're only starting to recognize that people interact with artificial intelligence and robots in ways that can demonstrate new phenomena with different qualities and interactions than some other tools people used in the past. These emerging technologies are accompanied by emerging interaction phenomena, and that means new expressions of human beliefs and behaviors that have to be understood before they can be addressed through informed design, policy, or training development decisions.

Historically, the military is the first place a lot of technologies get developed and widely field tested; the military has the money to conduct the research, as well as establish a supply chain infrastructure for mass production and distribution of a new technology, and a ready population that will have to use the new technology: the soldiers. In the case of EOD, that meant they are a group of people who have used various robots in their everyday work for years, which is an unusual situation I wanted to explore. I still want to explore this space with EOD and other MOS and their robots or AI use, such as drone operations, which is a very different situation and toolset altogether. Ultimately, I do hope some of the findings from my work can be integrated into military training, or policy strategy about interaction with robots, or even robot design, because this work can be applied to facets of the existing EOD world.

**IABTI: Thank you for making the time for our interview, Dr. Carpenter, and please let us know if there is anything the IABTI membership might be able to help you with in the future.**

*CARPENTER:* Thank you for inviting me. IABTI, EOD folks, and all people working in RSP for UXO have my support and respect, too, and I hope my work reflects those feelings. Thanks to the EOD who spoke with me. I had the opportunity to learn a lot and share what I learned with a lot of other people. My intention is to honor that experience by applying what I learned into research that can help EOD and other people who work with robots have successful and safer outcomes, all around.

***"Julie Carpenter has over 15 years of experience in human-centered design and human-AI interaction research and work. Her principal research is about how culture influences human perception of AI and robotic systems and the associated human factors such as user trust and decision-making in human-robot cooperative interactions in natural use-case environments. Dr. Carpenter earned her PhD and an MS from the University of Washington, an MS from Rensselaer Polytechnic Institute, and a BA from the University of Wisconsin-Madison. She is also currently a Research Fellow in the Ethics + Emerging Sciences group at California Polytechnic State University.***

***Dr. Carpenter's first book, Culture and human-robot interaction in militarized spaces: A war story (Routledge, 2016) expands on her research with U.S. military Explosive Ordnance Disposal personnel and their everyday interactions with field robots. The findings from this research have applicability across a range of human-robot and human-AI cooperative scenarios, products, and situations. Dr. Carpenter regularly updates her website with information about her current work at jgcarpenter.com."***