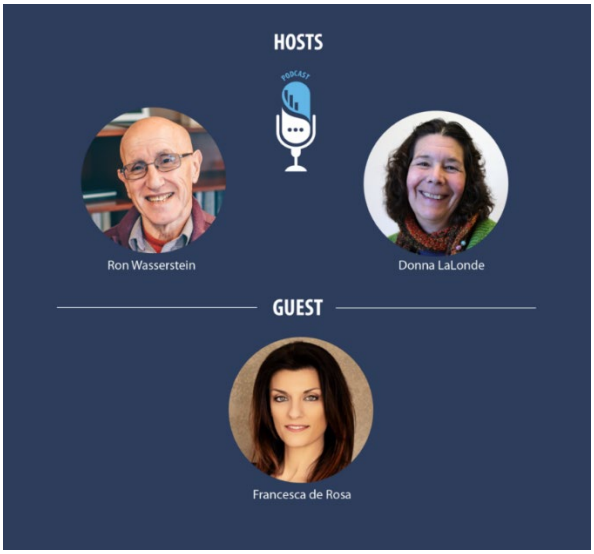

***Practical Significance* | Episode 64: Playing for Real: Serious Gaming for Preparedness and Decision-Making**

Donna LaLonde:
Well, welcome everyone to the April edition of *Practical Significance*. We are so super excited to be celebrating Mathematics and Statistics Awareness Month. I have a really special treat for you with our guest, Francesca, who will introduce herself. And so, Francesca, will you tell our audience a little bit about you, your background, and your day job?

Francesca de Rosa:
I'm Francesca De Rosa. I'm the founder of FDR Strategy, a company that helps organizations around the world build their serious gaming capabilities. I'm also a researcher in the field of game science.

And by background, I'm a cognitive engineer, and I have a PhD in artificial intelligence, specifically in interactive cognitive environments. So, the area of AI that really spans and bridges the development of new technologies and how they can support humans in a seamless way.

Before this adventure in AI, I actually studied civil and environmental engineering. I joined the NATO Center for Maritime Research and Experimentation right after my degree for an internship. And there, I discovered that there was a whole world behind security and defense that was looking at how to use new technologies, how to improve them, and how to improve decision-making in high-stakes environments.

And that really started fascinating me. And that's where I also started my adventure with gaming—being exposed to war gaming exercises in highly uncertain environments. And that really sparked my interest, and that's how the adventure started.

Donna LaLonde:
That's fantastic. And I know that the journey from civil and environmental engineering to AI expert in gaming is really interesting, for sure. Can you talk a little bit more about what

sparked your interest, especially in global preparedness, which I think is the space that you have been working in most recently?

Francesca de Rosa:
Absolutely. Just to provide a little bit of background, I recently have been working very much in this space of preparedness games because I've been collaborating for the last five years with the Center for Advanced Preparedness and Threat Response Simulation, an organization based in the U.S. that really is looking at how to use serious gaming for preparedness.

Let me first start maybe defining what we mean when we talk about preparedness games, because this is not the technical term—it's more of an umbrella term. When we talk about preparedness games, we are actually referring more to fields that are called serious games. Serious gaming, simulation gaming, war gaming—these are all different types of games, but they have the same overall objective, which is looking at a serious problem and trying to solve it.

And so, those are games that are not primarily designed for entertainment. There is a long tradition behind these games. This is not something new. Actually, the military started war gaming over 200 years ago.

But obviously, the field has evolved very, very much in the last decade, especially as technology has come in and as there is also a resurgence in the understanding of how useful these games can be.

When we talk about preparedness—let's say serious games—I'm using the term serious game as an overarching term. The games for preparedness are really normally understood as those games that look at improving civil protection—understanding how to prepare better against threats. Just think about hurricanes or, you know, tsunamis or any other climate-related problem.

But they also try to help improve the plans and the way in which organizations might have to respond whenever an emergency or crisis might come up. That's the most, I would say, formal definition of preparedness.

I like to take a little bit of a broader view of what preparedness means to me. To me, preparedness really refers to human readiness. It's about using these games to make sure that humans are ready to face uncertainty—to face threats or unknown situations. It is to help them improve the way in which they make decisions and therefore build that

resilience—resilience both at the individual level and at the organizational and societal levels.

My journey has definitely not been linear in this area. As I already mentioned, I started as a civil engineer with an internship at NATO. So normally, people coming into this field either have formal training in game design—normally in entertainment gaming—and then move toward this component of gaming, or they are hobby gamers, passionate about games, who love game design and then make that their daily job.

That's not how it started for me. For me, it started as an experience that was a little bit, potentially, forced upon me. And I need to say, I was very skeptical about the use of games. So, I absolutely can relate to people who do not believe in these methods because they don't know them—because I lived through that phase as well.

I started working at NATO on very exciting projects—counter-piracy, counterterrorism, energy security, infrastructure protection—so really more in the field of my studies. And just by chance—or because I was developing some models that were of interest to another group, the modeling and simulation group—I was moved and integrated into that group.

That group was building a very advanced simulator for that time that included a lot of innovative technologies—AI. And we're talking about more than 15 years ago, so AI, digital twins—really emerging technologies that were not widely available.

So, I could relate to that part of the task that was assigned. But at a certain point, somebody came and asked me to design a game that should use that simulator as part of a major military exercise.

And that term just didn't resonate with me. I didn't even know what serious games were. I had never heard about war gaming. The hype around war gaming and serious gaming was not there yet. Universities were not teaching serious gaming, And so, I had never encountered it.

That was really a niche area—known in some areas, mostly in the U.S. and the UK, but not well known in the rest of Europe. And so, I obviously started studying more about gaming and developed my first game.

And even then, I was not super convinced. I was an engineer and just didn't understand why we should be gaming. And so, we ran the exercise, and I saw a lot of the military experts in the room excited about the experience.

And even then, I was still not convinced, because I just felt that potentially that excitement,

that engagement, and that immersion were just purely coming from the opportunity to do a different type of exercise—a little bit less boring, right, than the normal tabletop exercises.

It's only when I downloaded the data from the simulator to perform the after-action review and to analyze the data that I really realized what I had in front of me. The power that these games have—the amount of data regarding behaviors, the way in which people operate—that can be collected through these games is enormous.

And that was probably the "aha" moment for me. That's when I really realized how interesting they were. I started, therefore, as a scientist using games as part of my research to collect the data I needed. And slowly, from a user of games, I started becoming also a researcher in this field.

Because while, on one side, I saw the potential, I also saw a lot of the difficulties or gaps in the design of these games and how we run them. And so, it really slowly became my area of research as well.

Ron Wasserstein:
That's amazing. And as I'm about to ask the question that I have—or several questions—understand that I can spell most of the things that you've said, and that's about the limit of my understanding.

So, with that in mind, I'm someone who is participating in one of these preparedness games. I suppose that what's supposed to happen for me is that, after doing this, I'm going to be better prepared to face real-world situations of some kind or another. So how does that happen?

And maybe you could help me understand that by describing something that you've developed.

Francesca de Rosa:
Absolutely. First of all, we need to distinguish between three major categories of games. So when we talk about these games, we say they help us improve decision-making, but they help improve decision-making in different ways.

We have games for learning, education, and training. And obviously, those improve decision-making of the individuals when they have to face these situations. But we also have two other categories—and I will go into more detail—that are awareness-raising games, as well as analytical games.

And it's very intuitive, right, to understand more the education and learning approach. This is exactly the kind of experience you mentioned. Participants are immersed in a simulated environment, and they are asked to operate following some rules and to, let's say, reach a certain objective.

This is all engineered in a way that would stimulate their learning around some specific aspects of decision-making. And it can be at a tactical level; it can be more at an operational or at a strategic level.

So, in some cases, you might have games where you literally learn how to operate some specific equipment—for example, firefighting equipment. But there are also games that are very abstract and actually require you to think about what could be factors that might impact policymaking, so that you are actually, as an organization—or as a high-level decision-maker—going to have better toolkits and skills when a crisis is unfolding to make decisions regarding that.

So that's at a high level. It's very important to mention that those learning, educational, and training games are becoming increasingly sophisticated with time.

So, you can have some that are very traditional, analog games, where you go through an emergency and you need to decide where to put your resources, and you develop your course of action using a map and encounters.

But new technology is really enabling us to create more interactive games. So those are environments in which the participants are immersed in a simulation that is also able to understand where their decision-making gaps are. So, they are adaptive—the simulation is adapting to their style, to their skills, and is also able to provide near real-time or real-time feedback to both the trainers and the learners, so that the learning outcome can really be improved.

And there are other kinds of games that are potentially less intuitive to understand, but as powerful as the learning ones are. The other ones that I mentioned—I don't have numbers—but I think that potentially 90% of the games that are out there are for learning and training.

But this little niche of awareness-raising and analytical games is gaining more attention because it's really very powerful.

The awareness-raising games are the ones that are more targeted at the general public and specific categories of participants. And they really are out there to make sure that people are aware of problems—potentially recognizing what the signals of threats are—and also how to respond as an individual, as a citizen, to a specific situation.

So, they are potentially meant also to create a first line of response and self-protection.

A very interesting application in this area is games that are specifically targeting younger kids, as I said, to recognize early signs of potential emergencies and crises. Because what psychology has recognized is that these little kids are amazing sentinels. They have the ability to scan the environment in a way that adults don't have anymore.

And so, very often, they're able to recognize these early signs, but they don't have the trust in themselves to actually go to adults and share their thinking regarding that. And so, these games are really targeting this audience to make them more confident in sharing those concerns that they have.

And then, as I said, there is this other niche of analytical gaming, which is really where I operate mostly, so I'm a little bit biased. I do have a great interest in this kind of game.

And those are games that are specifically optimized not for learning. They might have a learning effect as well for the participants, but what you're really trying to achieve with these games is collecting data regarding how potential experts—for example, emergency managers, firefighters, and so forth—take decisions in certain situations, and the behaviors of different target populations in certain situations.

And this is actually interesting enough—the most ancient form of operational research. So, as I said, it can be dated back 200 years, when games were really created first to understand how people behave and take decisions.

The reason why you might want to collect this data is to optimize the decision-making processes of organizations. You might want to use this data to optimize your plans, to pressure-test your plans, but also to develop completely new and innovative concepts of use and concepts of operations.

Now that we are obviously disrupting our operational environments by introducing new technologies and new ways of working—without potentially understanding what this means for humans, for emergency managers, for public health officials, and for all the decision-makers involved in emergencies and crises, both in the civilian and in the military world.

So, this is a very specific niche where we have been looking at using games to elicit expert knowledge where we didn't have the data to support our design of technology.

Data might not be available for many reasons. It might not be available because it's classified or because it's very fast outdated, and so, you cannot use it for the training or the design of your systems. And so, normally you resort to experts to understand more and collect this data.

But eliciting this knowledge from experts is very hard. It's very hard to get their time, it's costly, and for them it's very hard to verbalize their knowledge. And so, what you do is you actually have them play, and you observe and collect the way in which they interact with this environment. And that comes in a very natural form.

And then you can use this data to inform your designs. And that is what led me really to design some of my games, and specifically the K2AG framework, which is actually a completely new type of game.

Those games are dissecting decision-making in a way in which other games are not, following some specific human factor engineering models. And so, what happens is that the game structure per se is scaffolding the process of thinking through a problem.

And so, players are forced to go through a three-step approach, which is building your situational awareness, then taking a decision, and then acting. Because normally in games, we do tend to use and consider decision-making as a monolithic thing, and so, we just purely observe the outcome, which is the decision. But we are losing all the information of the actual decision process.

What these games—the K2AG—do is force the player to go through these steps and collect, in a stealth way, data regarding that. And that is done through the game board, so it's not an additional cognitive load on the player.

And so, for example, one of the game boards you might see in K2AG is a triangle on which I put, on the vertices, three hypotheses. And when the players are faced with a scenario where there is an unfolding situation that is uncertain—an unclear potential emergency—they have three hypotheses on the vertices of this triangle, which at the end of the day represent their belief state.

And they will be moving pieces—tokens—on this game board in a way in which not only does it visually support their thinking process, but also allows us, as scientists, to track how their belief gets updated as they receive new evidence.

And so, that helps us understand how individuals reach decisions, and how groups reach consensus over a decision, if they are in group settings.

But also, it's very interesting because you can model the position of the tokens on this triangle as, for example, subjective probabilities—considering the triangle as a simplex. And then you can really model and see very clearly where you have biases—anchoring biases, framing biases.

And it's interesting because it's so visual that it becomes very intuitive, even to experts with non-statistical or mathematical knowledge, where they are having a problem. Because you

can point to the elements of the game as a trainer and say, “This token should have moved, right? Why is it anchoring here?”

As you are getting new evidence, your belief should have been updated. And so, that is very powerful.

Ron Wasserstein:
That’s amazing, Francesca.

Donna LaLonde:
So, as we said at the beginning, Francesca, we are celebrating Mathematics and Statistics Awareness Month in April. And so, I wonder if you could think about mathematics, statistical, computational—from the perspective of students—and offer them some advice on what skills they should be developing, they should focus on, as they listen to and learn more about your work.

Francesca de Rosa:
Sure. I think this is a generally hard question to answer because this is such a growing field, and it’s so rich and so, transdisciplinary that there is so much we could say about this.

But what I really want to say is, you know, a well-designed serious game requires expertise not only in game design—it requires expertise in social science, behavioral science, psychology, human factors, engineering, complex systems thinking—so much, and definitely the ability to analyze the data.

It doesn’t matter if that game is for learning and training or for analysis. At the end of the day, you want to pull value out of that data and loop it back for learning to the learners so that they get feedback, or, obviously, to find an answer to your research question if it’s for analytical purposes.

So I would say that besides the hard skills—the mathematical and statistical skills—what is very important is to develop the ability to extract that value out of the data, not only performing the pure analysis, but understanding what that result is actually telling you, correlated to theories of decision-making, and understanding what the real implications are in operational environments of what you’re seeing in your data.

The ability to bridge that gap is, in my opinion, the most important moving forward.

Ron Wasserstein:
Working in an environment like that is super interdisciplinary. You must interact with people with lots of different kinds of expertise—expertise that's different from your own.

So, it seems like a secret to operating in that environment would be to be able to communicate well with people with different expertise. So, for students or people just getting started in their careers, what are some tips that you might have for how you develop that skill, or maybe how you developed that skill in the course of your professional life?

Francesca de Rosa:
Yes, I do believe absolutely that, given the interdisciplinary nature of gaming—I would say even transdisciplinary, because a game is an artifact that is intrinsically very transdisciplinary—it requires you to synthesize all this knowledge coming from different domains.

And that cannot really be done by one person. It requires the ability to work collectively and co-design a solution with experts in different domains—but, I would say, definitely with the owners of the problem. So, the specific experts in that field are your best partners.

And to be able to communicate, I think that the secret is an open mind, because that's the key to becoming semantically interoperable. You want to be able to communicate, and that is way more than just learning the vocabulary of that domain.

You absolutely need to do your homework. Come always prepared to every meeting. There is a lot of knowledge out there. If you want to operate in this field, you need to be curious. So, every time you start from scratch on a new design, go do your homework. Try to understand what the problems are in that domain. Try to understand how they solved them, how they're currently operating.

You might see gaps, but I would say the first thing is always to refrain from judging it, because that's what most of the time happens, right? We come to the table with the attitude, "I can't understand why they are not solving this problem. It's so clear to me what the solution is." But there must be so much behind that that you don't know.

So, I think that being open-minded, trying to create a space between you and the other experts where you build trust, where you start putting on the table the different perspectives that you have, is the key.

So, I don't feel that there is a single right answer to this. I can definitely share the way in which I've developed this skill and what works for me. The way in which I normally operate

is that I try to interpret what I can find—talking with experts and what I can find on the internet, in the literature, and so forth.

And I come to a meeting with a potential interpretation of the problem and what we want to do. But I honestly just put it on the table and say, “This is what I think I understand from what I read. Is this interpretation correct, or is there anything I’m missing?”

And that’s where the conversation starts. You will see that people will start kind of gravitating toward a center space where everybody is contributing—with an open mind, openness, and asking always why something is the way in which it is.

Because very often we are missing that portion, and we only look at the how.

Donna LaLonde:
That’s great advice, and I’m actually going to stay on the advice theme. You talked a little bit about the “aha” moment at NATO, where you became a believer in game science, but I’m wondering if you could think back about courses or professors or other people—mentors—and share with our audience what advice you would give your younger self to become the professional who you are today.

Francesca de Rosa:
Yes, absolutely. That’s an interesting story, actually, because what I didn’t say—to keep it short—was that although that was an “aha” moment, right, that I know changed the course of my career and so forth, that was not the moment in which I decided to spend my time on gaming.

I started recognizing the value of it, but I didn’t gravitate toward that area. I continued developing decision support systems. I worked very much focused on the human system integration aspects.

But I still remember, after a lot of years, actually, the scientist in charge of that project—very, very early on, when I joined that team—told me that I should pursue a PhD in AI in gaming. At that point, I’m not saying I gave a harsh answer at all, but I literally said, “But I’m a civil engineer. I’m not interested in gaming, and I’m not interested in AI. So no, I don’t think that’s my field.”

And so, that advice somehow stayed there, completely forgotten for years, until I slowly started building up this interest and moved toward this area of gaming.

And even when I applied for my PhD, I applied for a PhD in AI, but I was not planning to merge it with my interest in gaming. But by chance, my supervisor was also the president of the Serious Game Society. And so, when he learned that I had designed some games, he actually pushed me to merge the two interests.

And at that point, after a couple of conversations with him, I really decided that this could be the area where I wanted to develop further.

But only when I actually defended my PhD, did I go back to that day when the senior scientist—I don't know how—just told me, "You should go for a PhD in this area." That was years and years before I actually earned my PhD.

If I had the chance to give advice to my younger self, it would be: just don't answer like, "I'm a civil engineer, I'm not interested." Sit down and ask why. I'm still curious about what he saw in that moment that I didn't realize for myself.

And so,, you know, you can always disagree with the suggestion and decide to go for another path, but it's definitely interesting to understand why people think the way they do.

Ron Wasserstein:
Thanks for that. It's always interesting to me to hear about people's career paths and the twists and turns. And the advice that I've been giving lately to students and early-career professionals is that a career is not a linear thing—it's not a line. It's more like a story that keeps adding new characters and new plot twists, and you find yourself in places that you didn't know you would go.

And sort of in that line, I bet that there are going to be people hearing this podcast who think, "Wow, this sounds really cool. Game science sounds really interesting and impactful." Is this a good time to get into the field? And if so, why?

Francesca de Rosa:
Absolutely. I think that there has never been a better time. I need to say, when I joined, it was not a good time. I still remember a lot of people looking at me, going around with maps and cards, and saying, "Oh, there she goes again—she's cutting cards."

And while now gaming has been recognized as a well-established field—both from an operational perspective, so from a user perspective, but also from a scientific perspective—game science is now recognized as a science on its own.

And we see more and more universities teaching game science, either as a full course—a full master's degree or a bachelor's—or as integrated courses within broader curricula. And so, you can definitely have a formal education in this space.

And we see more and more interest growing around the world. And I do believe that the reason why this is a good time is that not only is it recognized as a field that has an impact, but the technologies that are currently out there—and that are currently under development—are potentially the biggest opportunity that we have to scale up this capability.

Until now, as I said, being a good game designer requires a lot of expertise in many domains, and not everybody can cover all of this. Having good game design teams was so costly and so resource-intensive for organizations that only a few around the world were really able to have these capabilities in-house and take advantage of these methods.

I do believe that AI is going to change the game here—not substituting the game designers and the experts—but if we really build these new technologies correctly to support game design, then this will give organizations the opportunity to create more games at lower cost, in shorter time, to analyze in shorter time the outcomes of these games, and therefore really make it more widely accessible.

So, there is a lot—also because, as I said, we still don't know how to fully use these technologies. This is a whole new open world for all the different areas, including gaming. So, there is a lot where new students can contribute from that perspective as well.

Donna LaLonde:
So, Francesca, I just have to ask—as a person who works on designing serious games—do you have a favorite entertainment game, or a game in that space?

Here's your final section, lightly edited and staying very close to the original wording:

Francesca de Rosa:
This is a hard question to answer because I'm really an anomaly, probably. As I said, a lot of game designers come with that hat—they love games for entertainment, they absolutely love complicated games, these war games that tend to span over days. That's absolutely not me.

I'm not a big fan of using my free time for gaming. And that's why you probably will see that my designs are very, very minimal. I want games that are quick, fast—fast to learn, fast to play, and go.

And that probably leads me to say that my favorite game—it's probably boring—but it's the UNO card game. Very simple, but that simplicity is what I love.

It's a game that has been in my life probably forever—since I was a little kid playing with my grandma, and now I'm playing with my kids. The ability to be learned fast by everybody around the world, at every age, and just enjoy a couple of minutes for a session is, in my opinion, what makes it so strong.

And what I love is that your cognitive load is not too high, so you can also enjoy a nice conversation as you are playing.

Donna LaLonde:
That's great. Well, thanks so much for spending Mathematics and Statistics Awareness Month with *Practical Significance*. We really appreciate it.

And we do have a couple of traditions on the *Practical Significance* podcast. One of the traditions is we always ask our guests what they are reading, listening to, or watching. So, share something that's on your TBR or playlist with our audience.

Francesca de Rosa:
Yeah, well, I need to confess that I discovered, during the pandemic, Korean dramas and Chinese dramas. So that's my current favorite way of spending my free time.

And I do have a very, very long pile of books that I'd love to read, but the one that is on top of that is actually a book I've already read a couple of times—it's *The Alchemist* by Paulo Coelho.

And the reason why I want to read it again is that every time I read it, it kind of tells me something different. It's very introspective. I read it once when I was finishing high school, once when I was about to give birth to my first kid, and so, I'm curious to read it again and see what it will tell me in this phase of my life.

Donna LaLonde:
Well, that's great—that's great advice. Maybe we'll be able to have you back sometime, and you'll tell us what advice you got from reading it again.

Thank you, and thanks everyone for joining us.

And our final tradition on *Practical Significance* is to have Ron's Top 10. So, I'll turn it over to my colleague Ron for his Top 10.

Ron Wasserstein:
Thank you, Donna.

Well, you know by now that we at the *Practical Significance* podcast always want to improve our listeners' lives. I've been doing a lot of reading lately, and I wondered what some classic works of fiction might have been like if they had been written with statisticians in mind.

So, here are the Top 10 classic novels—statistician's versions:

10. Great Expectations and Variances
Young Pip learns the hard way that knowing the expected value of your inheritance tells you very little without also knowing the variance.

9. The Scarlet P-Value
Hester is condemned to wear a $p > 0.05$ sign for the rest of her life and is forever excluded from the published literature.

8. Brave New Distribution
In this dystopian world, all citizens are assumed to be drawn from the same population. Outliers are not tolerated.

7. Pride and Confidence Intervals
Elizabeth Bennet refuses to accept any suitor whose results she cannot replicate. Mr. Darcy eventually provides adequate documentation of his methods.

6. To Kill a Confounding Variable
Atticus Finch argues passionately that correlation is not causation, but the enumerated jury has already made up its mind.

5. Catch-22 Degrees of Freedom
Yossarian is frustrated because Major Major's model overfits the data and explains absolutely nothing.

4. The Count of Monte Carlo
You knew this would be on the list. By running simulations, Edmond Dantès discovers that revenge is not ultimately satisfying.

3. Frankenstein's Prior
A statistician assembles a model from parts of other models but, horrified by what it predicts, abandons it.

2. The Brothers Kolmogorov-Smirnov Test
Three brothers from different but related distributions—and a burning question: is Fyodor's servant from the same distribution?

1. The Great Galsby
Galsby learns that lavish parties cannot make his data follow a normal distribution, as he is sure they once did.

Well, that's it for this episode of *Practical Significance*. We look forward to continuing the conversation next month.