Episode Book

EPISODE #5602

Why Crowds Kill Without Panic

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SYNOPSIS

Most coverage of crowd disasters leads with "panic," but the research says otherwise: victims of crushes almost never die running from anything. This episode digs into the mechanics of crowd turbulence — the density threshold where movement becomes involuntary, and the compressive asphyxia that kills people while they're still standing. From the 2021 Lag BaOmer disaster at Mount Meron to the Holy Fire ceremony at the Church of the Holy Sepulchre, we explore why religious gatherings are structurally prone to crushes, what engineering and AI monitoring have actually changed, and why the failure point is always upstream in crowd management — never downstream in emergency medicine.

TRANSCRIPT



Corn

Most coverage of crowd crushes leads with the same word. Panic. A crowd loses its collective mind, people trample each other, and the story writes itself. That framing is wrong, and it's been wrong in the literature for years.



Herman

It's not just wrong, it's backwards in a way that matters for prevention. The people who die in these events are almost never running from anything.



Corn

Which is exactly where Daniel wants to take us. He wrote in picking up a thread from a conversation about ancient travel, where pilgrimages came up as a social equaliser — one of the few reasons an ordinary person in the ancient world would travel a long distance. He wants to follow that thread into the present. Large crowds still converge on specific places for devotional reasons, and those gatherings produce densities of human beings you don't see anywhere else. Sometimes it ends in tragedy. He names Meron. He names the Holy Fire ceremony at the Church of the Holy Sepulchre, where Israeli police have to manage both the crush risk and the long-running territorial feuds between the church sects.



Herman

And then the part he actually cares about.



Corn

Right. He says the association between religious events and crushes is the easy part. What he wants is the harder question — what measures have actually been introduced over the years, and what international consensus has emerged about avoiding them. He draws the aviation parallel explicitly. Crashes are rare enough that when they happen, the industry treats them as lessons. He wants to know whether crowd safety works the same way, and how those lessons reach the planners and organisers on the ground.



Herman

That's the right question, and the answer is interesting because it's a yes and a no.



Corn

So let's start with the obvious one. Why do religious events in particular seem to produce these crushes?



Herman

Four structural factors, and they compound. The first is that the ritual itself requires density. At the Hajj, pilgrims have to perform specific rites in close proximity to other people, in sequence, on a schedule set by religious law. You can't spread them out the way you'd spread out a music festival crowd. The proximity isn't incidental to the event. It's the event.



Corn

So the crowd isn't a logistics problem layered on top of the ritual. It's baked into the theology.



Herman

Second factor, and this one is even harder to work around — fixed space and fixed time. The Kaaba is where it is. The Holy Sepulchre is where it is. You can't relocate a sacred site to a bigger venue with better egress. And the calendar is set too. Lag BaOmer is Lag BaOmer. You can't move it to a Tuesday in November when the weather's better and the crowds are thinner.



Corn

Every lever a normal event planner would pull is off the table.



Herman

Third, the flow geometry. Pilgrims converge on a single point — a shrine, a tomb, a basilica — and then they have to leave through the same bottlenecks they came in through. That's the classic crush shape. Converging flows, narrow exits, and a moment where two streams merge.



Corn

And the fourth?



Herman

The population itself. The Hajj draws from over a hundred and eighty nationalities. A study of pilgrim behaviour found that only about forty-eight percent adopted all the protective measures they were advised to take. Language barriers and limited access to information were the main reasons cited. So you have a crowd where half the people haven't received or understood the safety guidance, moving through a space with fixed geometry on a fixed schedule.



Corn

That's a lot of failure modes stacked on each other before anyone has done anything wrong.



Herman

And none of them require a single person to behave irrationally. That's the part the coverage keeps missing.



Corn

Let's get into the physics, because this is where it gets counterintuitive.



Herman

It does. Helbing and a group of colleagues did video analysis of the Jamarat Bridge in Mina — the stoning ritual site — and what they found was that at high enough densities, crowds develop stop-and-go waves. Then something they called crowd turbulence. Chaotic pressure waves that propagate through the crowd independent of anyone's intentions. People get moved by forces they cannot resist. Not because they're scared. Because the physics of the crowd has stopped being about individual decisions.



Corn

So at some point the crowd stops being a collection of people and starts behaving like a fluid.



Herman

That's the right way to think about it. There's a density threshold. Around five to six people per square metre is where movement becomes involuntary — you're no longer choosing where your feet go. And the average individual speed doesn't go to zero even at local densities of ten per square metre. So the crowd is still moving. It's just no longer moving because anyone decided to.



Corn

And what actually kills people at that density?



Herman

Pressure, not trampling. That's the misconception to kill. Victims typically die of compressive asphyxia while standing upright. They can't expand their chests because the pressure around them is too great. They're not under anyone's feet. They're vertical, and they suffocate.



Corn

Standing up.



Herman

Which is why the image of a stampede — people running over each other — is so misleading. Most of the dead in these events never fell until after they'd stopped breathing.



Corn

There's a paper from Moussaïd and Helbing on the cognitive side of this, isn't there?



Herman

There is, and it's the piece that closes the loop. They showed that pedestrians follow simple visual heuristics — you steer toward the gap, you maintain a bit of distance from the person ahead, you match the speed of the people around you. Ordinary rules. And the combination of those ordinary rules with body collisions generates crowd turbulence at extreme densities. No panic required. No malice. Just people doing what people do, at a density where the emergent behaviour turns lethal.



Corn

So the crowd doesn't have to be irrational to kill. It has to be dense.



Herman

And it has to be funnelled. Bottlenecks are where this happens. There's modelling work on adult-child pairs in crowds from last year that confirms the same thing — making the corridor wide enough after two flows merge is the critical variable. The danger point isn't the crowd. It's the moment two streams become one.



Corn

Let's put some names to this. Meron.



Herman

April thirtieth, 2021. Lag BaOmer, on Mount Meron in northern Israel. Forty-five dead, a hundred and twelve injured. Israel's deadliest civilian disaster.



Corn

And the analysis of it is fascinating, because the framing the researchers used was that it was a silent mass casualty incident.



Herman

That's the phrase. It lacked a dramatic, noticeable trigger. No bomb, no building collapse, no fire. Nothing that would tell you, in the first thirty seconds, that a mass casualty event was underway. Which is the crux of the problem with crushes. They kill quietly. By the time anyone recognises what's happening, the pressure wave has already done its work.



Corn

And the medical response was actually good.



Herman

It was. Magen David Adom had done pre-event planning. They'd run on-site mass casualty drills. They had a rolling reinforcement system where ambulances kept arriving in waves. And they evacuated casualties rapidly. The emergency medicine was, by any reasonable standard, well-prepared.



Corn

And forty-five people still died.



Herman

Forty-five people still died. That's the lesson. The failure was upstream, in crowd management, not downstream in emergency medicine. You can have excellent trauma care and it won't save people who suffocated before anyone knew there was an incident.



Corn

So the Meron case is almost a proof of the systemic-failure thesis. You can fix the response and still lose everyone, because the response was never the problem.



Herman

Right. And it's why the recommendations out of that analysis were about density monitoring and crowd flow, not about more ambulances.



Corn

Let's talk about the Holy Fire, because that's a different shape of problem entirely.



Herman

It is. The Church of the Holy Sepulchre is a small basilica, and the Holy Fire ceremony draws a vast number of pilgrims who want to be inside it. Which is already a crush geometry problem. But layered on top of that, the site is shared between the Greek Orthodox, Armenian, Coptic, and Franciscan custodians, and those communities have historic territorial disputes over the space that go back centuries.



Corn

So the Israeli police aren't just managing crowd flow. They're managing crowd flow while refereeing a religious dispute that predates the state.



Herman

And you can't just impose a single authority's crowd plan, because no single authority owns the site. Any change to how people move through the building has to be negotiated with communities who are extremely sensitive about any change to how people move through the building.



Corn

Because control of the space is itself the thing they're fighting over.



Herman

So the crowd-safety problem is entangled with religious diplomacy in a way that has no real analogue at a stadium or a festival. You can't just widen the exit if widening the exit changes which community's procession uses which door.



Corn

That's the hardest version of this problem. You can't redesign the theology. You can only redesign the infrastructure around it, and here even the infrastructure is contested.



Herman

Which is why the Holy Fire is one of the cases where the science is clearest and the implementation is hardest. Everyone involved knows what the density thresholds are. Nobody can unilaterally act on them.



Corn

Alright. So that's the mechanism. Crushes are systemic failures, they're generated by ordinary behaviour at extreme density, and the failure point is upstream in flow management, not downstream in medicine. Which brings us to the question Daniel actually cares about. What have we done about it?



Herman

Let's start with engineering, because that's where the biggest wins are. The Jamarat Bridge is the flagship. It was rebuilt completely — multi-level, one-way flow throughout, capacity for millions. That wasn't a tweak. That was a ground-up redesign in direct response to repeated disasters at the same site.



Corn

And the principle there is that you're not trying to manage the crowd. You're trying to make the crowd's movement physically impossible to funnel into a lethal configuration.



Herman

One-way flow systems, staggered scheduling of pilgrims so you're not merging everyone into the same window, grouped arrival times. The Hajj literature specifically assesses the best ways of grouping and scheduling pilgrims, because the timing is as important as the geometry.



Corn

What about the softer operational stuff?



Herman

Crowd simulation models, to pre-test capacity and flow before anyone shows up. You run the event in software first. You find the pinch points on a screen instead of finding them with forty-five people dead.



Corn

And video monitoring with real-time density estimation, which has moved a long way.



Herman

It has. There's recent work on an AI system tested at Kumbh Mela — the largest peaceful gathering on Earth — that does real-time density estimation, anomaly detection, and predictive congestion modelling. The frontier here isn't measuring the crowd. It's predicting the crush before it forms. You watch the density gradient, you see the stop-and-go waves starting to develop, and you intervene before the turbulence sets in.



Corn

So the intervention window moves earlier.



Herman

Much earlier. And that matters because of the silent MCI problem. If the crush has no dramatic trigger, then rising density itself has to be the alarm signal. You can't wait for a visible incident, because by the time it's visible, it's over.



Corn

Which connects to the Meron lesson about pre-positioning.



Herman

Pre-positioned medical infrastructure, drills, and treating density as the trigger rather than casualties. That's the operational shift.



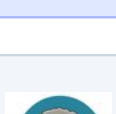
Corn

Here's where the aviation analogy gets interesting, though, because Daniel's right that the parallel is real, and it's also incomplete in a way that tells you something.



Herman

It's incomplete in governance. The science has converged. The 2019 review — de Almeida and von Schreeb, sixty-four publications — found that the irrational-panicking-crowd model has been progressively replaced by the systemic-failure model. That's a genuine consensus in the literature. Investigate the chain of failures, don't blame the crowd. Same discipline as an air accident investigation.



Corn

But aviation has a single global regulator with binding authority, mandatory reporting, and standardised investigation. Crowd safety has none of that.



Herman

None of it. There's guidance — the WHO mass-gathering frameworks, a substantial academic consensus — but enforcement is national or local. There's no ICAO for crowds. There's no equivalent body that can say this site fails the standard and compel a fix.



Corn

And the 2019 review notes that the field still lacks standardised definitions and rigorous post-event analysis. So the lessons-learned discipline itself is less mature than aviation's.



Herman

That's the finding. It's not that nobody knows what to do. It's that there's no machinery for making the knowledge binding, and no consistent method for extracting the lesson from the event in the first place.



Corn

The international consensus is real in the science and weak in the governance.



Herman

That's the honest summary. Everyone who studies this agrees on the mechanism and the interventions. Nobody can compel anyone to implement them.



Corn

Which brings us to the counterintuitive takeaway, and I want to sit on this for a second. Crushes are not caused by too many people.



Herman

They're not. They're caused by density gradients, bottlenecks, and converging flows. The same number of people spread across an open field is completely safe. Funnel them through a gate and it's lethal. The number didn't change. The geometry did.



Corn

Religious events are the hardest case, because the geometry is sacred. You can't redesign the theology. You can only redesign the infrastructure around it, and sometimes, as at the Holy Sepulchre, even the infrastructure is under somebody else's jurisdiction.



Herman

That's the state of play. The science is settled. The engineering is proven. The governance is patchy, and the hardest sites are the ones where the governance problem and the theological problem are the same problem.



Corn

The most dangerous thing in a crowd isn't the crowd.



Herman

It's the moment the crowd stops.



Corn

Because that's when the pressure starts building and nobody can move and the people at the back keep arriving.



Herman

The people at the back keep arriving. That's the whole thing. The crowd at the front has nowhere to go, and the crowd at the back doesn't know that yet, and the pressure transfers through the middle.



Corn

I spent three days at a festival once counting people through a gate with a clipboard. Not a religious event. Two stages, and the organisers had a bottleneck between them that nobody had really thought about.



Herman

How did that come about?



Corn

I was doing crowd-safety consulting. Mid-sized outdoor festival, maybe fifteen thousand people. And the layout had a natural pinch point where the path between the two stages narrowed. On paper it was fine. In practice, when one set ended and the other was about to start, you got two streams converging into one corridor about four metres wide.



Herman

That's the merge point.



Corn

That's the merge point. So I stood there with a clicker counting people per minute, and for most of the day it was fine. Then the headline act on the second stage started, and the first stage emptied, and I watched the density go from comfortable to something else in about ninety seconds.



Herman

What did you see?



Corn

What I saw was people stopping. Stopping. The front of the crowd could see the second stage and couldn't get to it, and the back of the crowd was still walking, and in the middle there was a group of maybe two hundred people who couldn't move in any direction. And I remember thinking, this is the thing. This is the moment. The stopping.



Herman

And?



Corn

It nearly went. There was a steward — a kid, maybe nineteen, working his first event — who was standing at a side gate that wasn't on any plan. It was a service gate, locked, but he had the key because he'd been told to keep it locked and he'd been given the key to do that. And he looked at what was happening, and he unlocked it, and he opened it.



Herman

He improvised.



Corn

About a hundred and fifty people went sideways through a gate that the crowd management plan didn't know existed, and the density in the main corridor dropped, and nothing happened. No incident. No report. The festival went fine.



Herman

The model would never have caught that.



Corn

The model would never have caught that. The simulation would have shown the corridor as adequate, because on average it was. The density estimation would have flagged the spike, but by the time you've flagged it and dispatched someone, you're already in the window. What saved it was a nineteen-year-old with a key who could see the space and act in the moment.



Herman

That's the last line of defence.



Corn

I've never been able to unsee it. Once you've watched a crowd stop, you see it everywhere. You see it at train stations. You see it at airport security. You see it at the entrance to a stadium. The moment when the front can't move and the back doesn't know yet.



Herman

It changes how you read the research.



Corn

It does. Because the research tells you to widen the corridor, and it's right. But the research can't tell you that the corridor is fine on paper and lethal in practice because of the timing of two stages. And it can't tell you that the fix might be a gate that isn't on the plan and a person who noticed.



Herman

The science gets you most of the way.



Corn

The science gets you most of the way. The last bit is someone on the ground who knows the space and can act. And that's the part you can't simulate, and it's the part that's hardest to institutionalise, because the whole point of the plan is that you don't rely on improvisation.



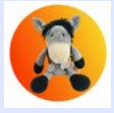
Herman

But you do anyway.



Corn

You do anyway. Every time.



Herman

The question I keep coming back to is this. If the science of crowd dynamics is now this clear — if we know the density thresholds, if we know the mechanism, if we know the interventions — why does the governance lag so far behind aviation?



Corn

Because aviation has a single regulator with teeth, and crowds don't. There's no ICAO for pilgrimage sites. And the hardest sites are sovereign, or sacred, or both.



Herman

What would a binding international crowd-safety body actually look like?



Corn

I don't know. And I'm not sure it could work, because the thing that makes aviation regulation possible is that everyone agrees a plane crash is bad and nobody has a theological stake in the design of a wing. At the Holy Sepulchre, the design of the building is the dispute. You can't regulate your way past that.



Herman

The frontier isn't better medicine. It isn't even better AI.



Corn

It's better integration of the science into the messy, political, sacred reality of pilgrimage. Which is a much harder problem than density estimation, and it's the one nobody has solved.



Herman

The Meron lesson is that even excellent emergency response can't compensate for upstream failures. The Kumbh Mela work points to a future where you predict the crush before it forms. But neither of those solves the Holy Sepulchre problem, where the crowd plan is a diplomatic negotiation.



Corn

The last line of defence is still a person with a key who can see what's happening.



Herman

That's the honest place to land. The science is real. The governance is patchy. And the human on the ground still matters more than any of us would like to admit.



Corn

If you found this interesting, the full episode is at my weird prompts dot com, and we'd love a review.



Herman

Thanks to our producer, Hilbert Flumingtop.



Corn

This has been My Weird Prompts.



Herman

We'll be back soon.