Structure Drives Behavior
July 2023
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One of a series expanding on my article Elements of a Systemic Sensibility.[1]

I was talking to my colleague John Carnwath a few months ago. He had asked me to comment on the systemic implications of a study he had just completed at Wolf/Brown, where he works. I casually threw off the observation that "structure drives behavior," as system thinking types are apt to do.

John paused. Then he asked me, "What exactly is structure?"

If Systems Thinking has a golden rule, it's that "Structure Drives Behavior." We say this all the time - or at least I do - as a shorthand way of reminding people that we habitually overestimate the role of individual choice and underestimate the role structures play in making things happen the way they happen.

John comes by his question honestly. I don't think that the field has ever explained what the "structure" part of "structure drives behavior" means in a way that managers and leaders can understand and use.

This piece is an attempt to answer John's question. I start by going back to the emotional reason why I think this idea, that structure drives behavior, is so central to so many systems thinkers.

For a lot of us, I think it started with The Beer Game.

Baptism by Beer Game
Structure does drives behavior, or course. It's true. But in the world of system dynamics, it's more than just a sound idea. It's like dogma.

It's a statement of faith that hidden forces coerce the choices that people make without them being aware that they are being coerced. It provides an antithesis to an idea that our culture reveres, that a single heroic individual can move history. "Structure drives behavior" is something we feel as much as we think.

Here's why I think we feel it.

Most of us who study systems played "The Beer Game" as we were beginning to learn about the field - not the drinking game, a real board game[2] designed to illustrate systemic dynamics.

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[1] https://www.johnshibley.com/_files/ugd/c73dc5_f3459f018eca4fa7af4ff8a9a4e73562.pdf

[2] Beer distribution game. (2021, November 29). In *Wikipedia*. https://en.wikipedia.org/wiki/Beer_distribution_game#:~:text=8%20External%20links-,History,his%20work%20on%20system%20dynamics.

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Not every person who plays the Beer Game becomes a systems thinker, but I bet every systems thinker has played the Beer Game. [3]. It's the closest thing the field has to a Baptism. It's when many of us **got** that structure drives behavior, got it in our guts as well as in our heads.

The Beer Game is a simulation of a distribution systems for beer from the factory to customers. A team of four to eight players run a store, distribution center, warehouse, or factory, usually on a large vinyl game board that covers a table. The only decisions they make as a player is how much beer to order or manufacture.

A key feature of the game is a series of delays: delay getting orders from the store to the factory, and then delays getting beer from the factories to the stores.

With every turn, the team charts their inventory and their backorder.

And here's the thing - every time people play the beer game, no matter who they are, those charts look the same.

[3] Dizikes, P. (2013, October 22). *The Beer Game*. MIT Technology Review. Retrieved April 27, 2023, from https://www.technologyreview.com/2013/10/22/175775/the-beer-game/

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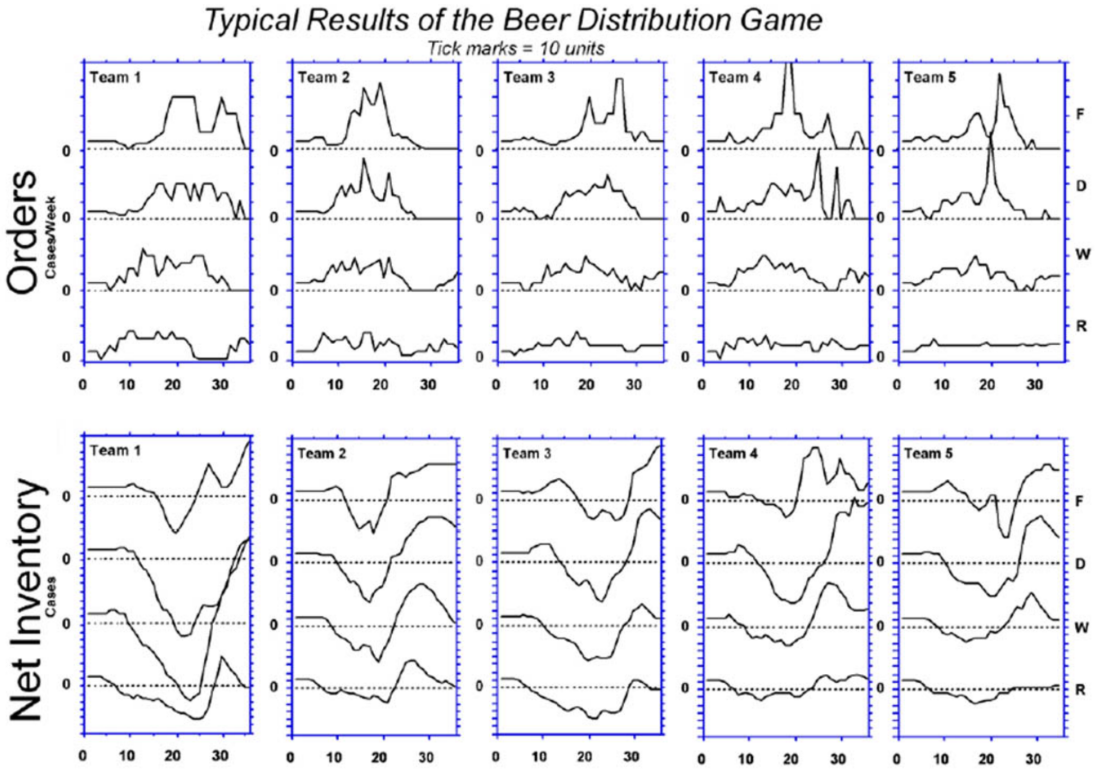

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Note the similarities between the charts for the five teams. None of them are identical and they all show the same pattern. Orders begin steady, peak, then decline. Inventory drops and then soars. Every time.

I remember the first time I played The Beer Game. There were five teams. At the end, we all posted our charts on the wall: five teams times four positions, twenty charts. Our charts looked exactly like the charts above.

While we all thought we were making individual decisions based on our personal reasoning, there was no denying the data. We all did the same thing without deciding to.

It wasn't us. It was the structure. That what the instructor told us, and we all nodded, like we had just received the wisdom. It's only partly exaggerating to call it a conversion.

That's when I **got** "structure drives behavior" in my gut.

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[4] (2020, August 19). *Supply Chain Design and Planning*. ConspecteCom. Retrieved April 21, 2023, from https://conspecte.com/en/Supply-Chain-Management/supply-chain-design-and-planning.html

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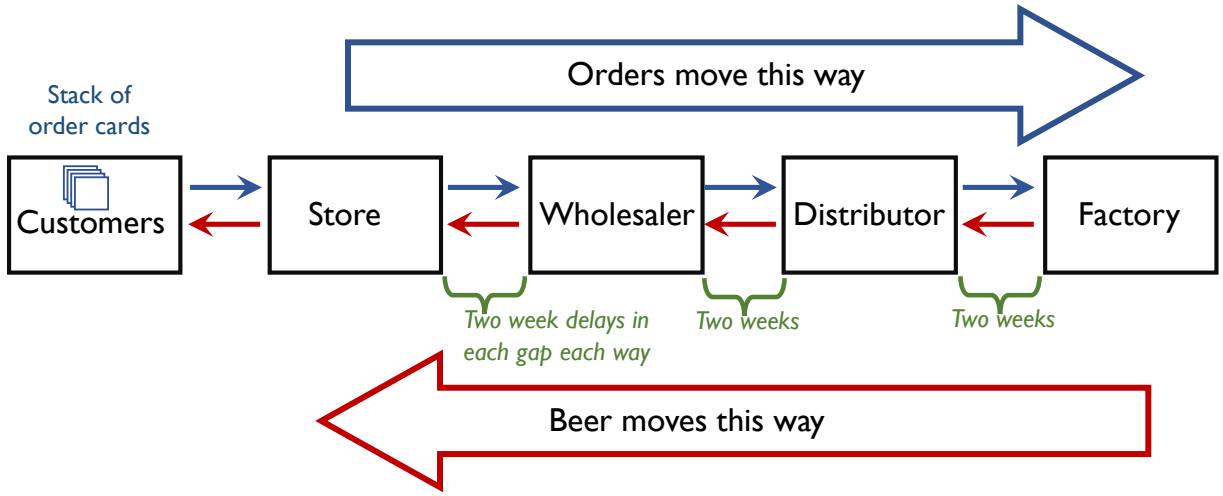
Back to John's question… if structure in the Beer Game drove our behavior, what **part** of the Beer Game **is** the structure? Let's look more closely at how the Beer Game operates. Maybe that can give us a clue.

The Beer Game as a system

The Beer Game has four different stations. They represent physical places: a store that sells beer to the public, a wholesaler that sells beer to a store, a distributor that receives beer from the factory to distribute to wholesalers, and the beer factory itself.

There are customers too, but they don't make decisions. In the Beer Game the customers are a stack of small square cards, each of which has a number written on it representing the total orders from customers for one week.



A round of the Beer Game takes a fictious week, and the week begins when the store turns over the next card to see how much beer was sold last week. They remove that beer from their inventory and initiate an order for beer by writing that week's order on a slip of paper and moving it into the gap between them and their wholesaler.

That round ends, the next one begins, and the slip of paper still sits there, in the gap. That's because there is a two-week delay between stations as orders move up the supply chain to the factory and as beer moves down the supply chain from the factory to the store.

On the next turn, the wholesaler finally gets to see the order. They move that many cases of beer into the gap between them and the store, where it will sit for two more turns before the store can get it. It's the same two turn delay all the way up and down the supply chain.

I wrote earlier that those delays were an important feature of the Beer Game. You can see how influential they are by looking at the picture. It takes two weeks (two turns in the game) for the slip of paper from the store to reach the wholesaler, and two more weeks for the order from the wholesaler to get to the distributor, two more again for the distributors order to get to the factory.

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Add in the same delays on the trip the beer takes from the factory all the way back to the store, and you get a total of 12 weeks between the store asking for beer and that beer arriving. That's a long time.

Answer to John
The Beer Game has five things with a visible analog in the world: customers, a store, a wholesaler, a distributor, and a factory. The game also has delays, which are not as concrete as a store or a factory but represent an aspect of time associated with… with what?

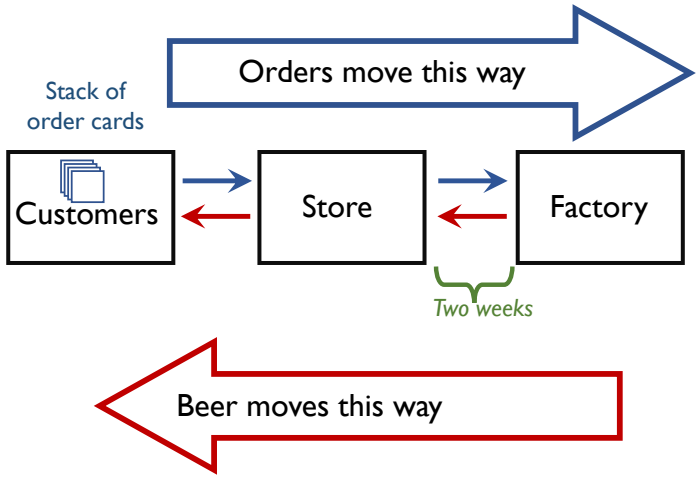
The delays don't really belong to any of the things. What **do** they belong to?

The delays are a feature of the connections **between** the things in the Beer Game. That feature is a two-week delay. Because the connections control the way information flows through the system, the delays built into the connections imped that flow. They keep the system from balancing as easily as it might if the delays were not there or not as long, which leads to the dramatic ups and downs documented in the charts.

Everything - beer inventory and backorders, osculates up and down, the way the temperature of your shower goes up and down because of the delay between turning the shower knob and feeling the change in water temperature.

Shorter delay, less up and down. Longer delay, more up and down.

Play this thought experiment… what if THIS was the Beer Game?



This is a brew pub. Fewer steps between factory and customers and far few delays. Fewer delays, smaller oscillations - and fresher beer!

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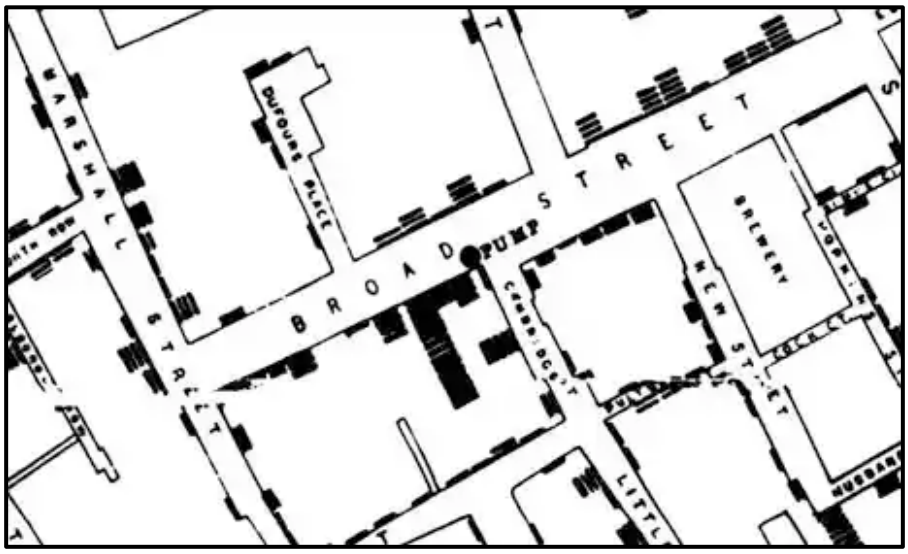
So for my friend John, let me suggest this provisional working answer to the question "What is structure?"

> *When we say that "structure drives behavior" we mean that the **things** in a system, the way those things are **connected**, and **delays** in those connections, create a circle of causes and effects that make some outcomes much more likely than others.*

OK… let's test this definition against a case.

Dr. Snow and the cholera map[5]

Look at this map, famously drawn by Dr. John Show during the 1854 cholera epidemic in London.



It shows the number of deaths from cholera (one for each bar) and the water pumps around London. The map established a strong correlation - shown here - between the Broad Street pump in the center of the map and a lot of cholera deaths.

The pump is one thing in the system that was this cholera epidemic, but not the only thing. To see the whole structure, we need to understand how a cholera epidemic works, to see the things and their connections.

Cholera makes people vomit and gives them severe diarrhea. Those body fluids carry cholera bacteria, which can infect more people, who generate more cholera bacteria. People get infected by these bacteria, and the cycle begins again.

Looking at it as a circle…

[5] The Cholera Epidemic and John Snow's map has been written about extensively. Check out this treatment by The Guardian. Rogers, S. (2013, March 15). *John Snow's data journalism: The cholera map that changed the world*. The Guardian. Retrieved April 24, 2023, from https://www.theguardian.com/news/datablog/2013/mar/15/john-snow-cholera-map

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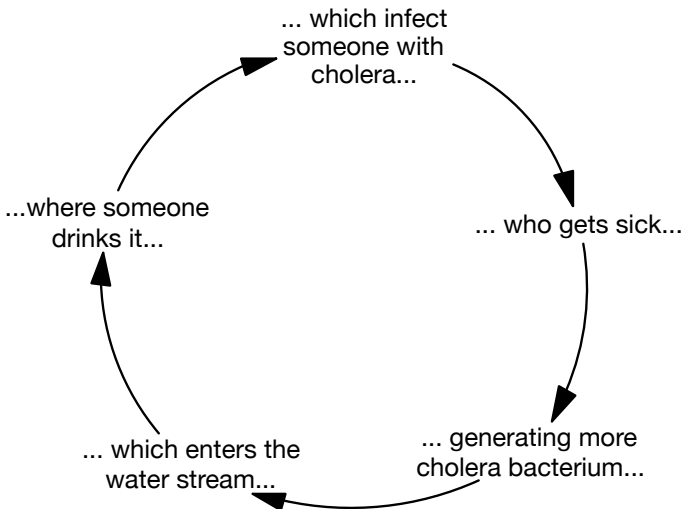
Someone gets infected with cholera. They get sick and generate more cholera bacteria. The bacteria enter the water system where someone else drinks it and gets infected with cholera.

This version of the story has five things and five connections.

From a systems perspective, this is a classic reinforcing structure. Left alone, all these elements will continue to increase like a snowball rolling downhill.



Our definition was …

> *When we say that "structure drives behavior" we mean that the **things** in a system, the way those things are **connected**, and **delays** in those connections, create a circle of causes and effects that make some outcomes much more likely than others.*

We can see all those elements at work here. The things (shown in the text) and the connections (the arrows) worked together to create an epidemic.

Delays? The longest delay in this system is the period after infection but before symptoms appear, in general two to three days. It may seem minor, but consider this - if there was no delay, people would get sick immediately after drinking the infected water. If that happened, people would make the connection between the water and getting sick. No one intentionally drinks something that makes them sick immediately.

The problem at Broad Street was that the sewer system near the Broad Street pump was leaking cholera bacteria into the drinking water.

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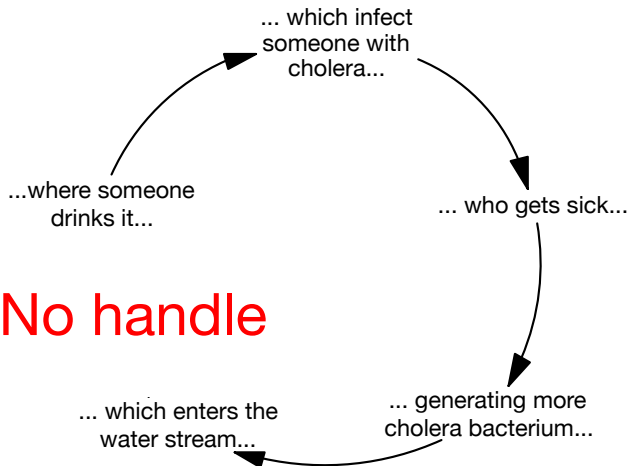
What Dr. Show did to fix the problem was systems thinking genius. He broke one of the connections in the circle.

How?

He took the handle off the Broad Street pump.



Changing the Structure in a System
Right after system thinking teachers lead the Beer Game, they teach you this -

To change a system, add a link, break a link, or reduce a delay.

Dr. Snow's action is the prototype for changing the structure driving a behavior. He broke the easiest link to break. By denying people access to the infected water, he turned a run-away reinforcing process into a linear chain of events with an end, but no feedback.

He turned a circle into a line, and a line is not a system.

And he did it without a systemic analysis, without drawing the circle that I did. Medicine wasn't even sure how cholera spread in 1854. He had a well-informed intuition about what to do… one might almost say a sensibility.

"In theory there is no difference between theory and practice, while in practice there is." Benjamin Brewster
I think the cholera case confirms our preliminary definition…

> *When we say that "structure drives behavior" we mean that the **things** in a system, the way those things are **connected**, and **delays** in those connections, create a circle of causes and effects that make some outcomes much more likely than others.*

All the elements are there, and, moreover, the solution was to change the structure dramatically by breaking a connection.

From a theoretical point of view, I'd say that's right. But as someone who works with actual organizations dealing with actual problems, it's too general a definition of structure to help. It doesn't answer the question "Where do I start?"

For the real world, I go back to this…

To change a system, add a link, break a link, or reduce a delay.

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… and suggest that, for **practical** purposes, we first think of structure as the **connections** between things in a system.

That's approach encourages us to focus on the links and to do something about them, and it's also the approach that draws our attention to what is sometimes missing from an analysis, which are the connections.

In real life, the "things" in the Beer Game might be so frustrated that they would blame the other "things": the warehouse would blame the distributors, the factory would blame the stores, and they would all miss that the central problem is how the delays slow communication and distribution **between** the things.

The secret to solving the Beer Game is the same as for the cholera epidemic in London. You have to change the structure[6] by finding a way or ways to dramatically reduce the delays that are embedded in the connections between things.

To intervene there, you first must **see** that there are connections and know how to work them. And to see them, you must suspect they are there in the first place.

Connections knit things into systems. Want to deal with a structure driving a behavior? Start there.

Conclusion

I'm advocating that "structure drives behavior" is a **sensibility** about the world. I've explored that idea here with pictures which look alarmingly rational, but you don't need the pictures.

"Structure drives behavior" is an idea, but system thinkers don't go through an analytic process to suspect that impersonal structural elements are affecting what people do. They sense it. Analysis follows intuition.

[6] Another structure that drives the behavior of the system in the Beer Game is the rule, imposed by the instructor, that the people running the four stations cannot communicate with one another. That rule is also part of the structure and breaking it to enables collaboration between players and can change the way the game plays out.

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