GST 85 — PTP, TPT and Causal Duality

Formal Description

The causal reality developed in these course modules can be represented as a continuing alternation of processes (**P**) and transfers (**T**):

... P → T → P → T → P → T → P ...

Processes receive, transform and generate causal inputs and outputs, while transfers physically connect spatially separate processes. The underlying causal organisation does not inherently divide into PTP or TPT units. These arise when an observer places conceptual boundaries around different portions of the same continuing sequence.

A Process–Transfer–Process (PTP) representation encloses two processes and the transfer connecting them:

$P_1 \rightarrow T_1 \rightarrow P_2$

PTP therefore foregrounds a causal event or interaction: an originating process produces a transfer through which it influences a receiving process. Successive PTP units can be connected because the receiving process in one interaction may become the originating process in another:

$[P_1 \rightarrow T_1 \rightarrow P_2] \rightarrow [P_2 \rightarrow T_2 \rightarrow P_3]$

The shared component is **P_2**.

A Transfer–Process–Transfer (TPT) representation instead encloses an incoming transfer, the process upon which it acts, and a resulting outgoing transfer:

$T_1 \rightarrow P_1 \rightarrow T_2$

TPT therefore foregrounds a system or process perspective: an input enters a process, is transformed or integrated through its operation, and contributes to an output. Successive TPT units connect through their shared transfer:

$[T_1 \rightarrow P_1 \rightarrow T_2] \rightarrow [T_2 \rightarrow P_2 \rightarrow T_3]$

The underlying causal reality represented by PTP and TPT is identical. The distinction is consequently epistemic rather than ontological: PTP and TPT are complementary decompositions of the same causal organisation.

The two representations nevertheless emphasise different features. PTP makes interactions, branching, convergence and the necessity or sufficiency of causal transfers particularly visible. TPT makes recurring relationships between inputs, process functioning and outputs particularly visible. PTP therefore facilitates explicit logical analysis of causal networks, whereas TPT facilitates recognition of recurring patterns in process behaviour.

This complementary relationship provides an important connection between causal theory and systems theory. PTP provides an event-based perspective upon causal interaction; TPT provides a systems-based perspective upon process functioning. Both describe the same underlying physical causal reality.

Plain English Explanation

Imagine that water flowing into a reservoir causes its water level to rise.

We could concentrate upon the interaction:

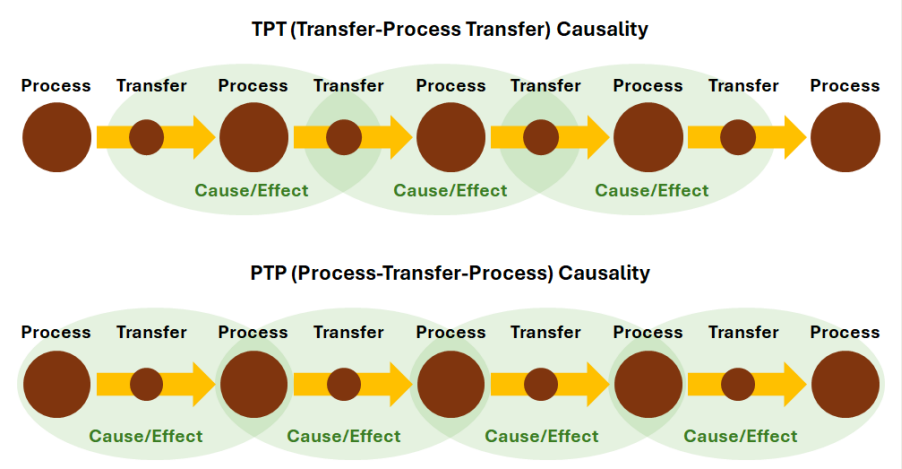
Upstream process → transfer of water → reservoir process

This is a PTP representation. We are asking how one process physically influences another.

Alternatively, we could concentrate upon the reservoir:

Water entering → reservoir process → water leaving

This is a TPT representation. We are asking what happens to the system when it receives particular inputs and how this affects its outputs.
Nothing in reality has changed when we move between these representations. We have moved the boundary of our attention.
This becomes clearer if we start with:
... P → T → P → T → P → T → P ...
and place brackets around it in different ways.
PTP gives:
[P → T → P] → [P → T → P]
TPT gives:
[T → P → T] → [T → P → T]
It is rather like looking at the same landscape through two windows positioned slightly differently. Each makes some features particularly easy to see.
PTP is useful when asking questions such as:
What process caused this transfer? Where did the transfer go? Which other causal pathways converged upon the receiving process? Which transfers were necessary? Could an equivalent transfer have come from another source? Where did the pathway subsequently branch?
TPT is useful when asking:
What inputs did this process receive? How did it behave under those inputs? What outputs resulted? Does the same pattern recur when similar inputs occur again?
This helps explain why systems science frequently adopts an **input–process–output** representation. We can recognise that a system repeatedly behaves in a particular way when it receives particular inputs without necessarily knowing every physical causal pathway responsible for that behaviour. Suppose, for example, that heavy rainfall is repeatedly followed by increased river flow. We may recognise the recurring pattern and use it predictively before we fully understand all of the infiltration, runoff, drainage, groundwater and channel processes involved. TPT is particularly compatible with this kind of pattern recognition.
PTP encourages us to decompress the relationship further. We ask what physical transfers connect the processes and how multiple causal contributions branch and converge. It is therefore particularly useful for logical causal analysis.
Neither perspective is superior. They perform complementary epistemic functions.



Examples

Consider a conversation between two people. From a PTP perspective, one person's cognitive and speech processes produce sound waves that are transferred through the air and influence the auditory processes of the other person:

Person A's processes → sound transfer → Person B's processes

Attention is directed towards the interaction between the two agents.

From a TPT perspective, we might instead concentrate upon Person B:

incoming speech → cognitive processes → spoken response

We are now treating the person as a system receiving an input, processing it and producing an output. The spoken response can subsequently become the input to Person A. The same conversation can therefore be examined as interconnected PTP causal events or interacting TPT systems.

A river catchment provides another example. A hydrologist might recognise a recurring relationship:

rainfall input → catchment processes → river-flow output

This TPT representation can be useful for recognising and predicting catchment behaviour. A more detailed causal investigation might instead identify transfers of water between rainfall, soil, groundwater, drains, streams and rivers. PTP representation helps expose this network of causal interactions.

A manufacturing process can similarly be examined through TPT as:

materials and instructions → manufacturing process → finished product

or decompressed through PTP into the many physical interactions through which machines, materials, operators and control systems influence one another.

These are not rival explanations. They represent different selections from the same causal organisation for different analytical purposes.

Provenance and Links

The systems-based TPT perspective has clear antecedents in input–process–output models, which have been widely employed across systems theory, engineering, computing, biology and organisational analysis. General Systems Theory, particularly the work of Ludwig von Bertalanffy, helped establish the importance of examining open systems in terms of their exchanges with their environments rather than treating systems as isolated entities.

The event-oriented PTP perspective has affinities with mechanistic approaches to causality, which seek to explain phenomena through the entities, activities and interactions connecting causal antecedents with their consequences. Such approaches encourage causal relationships to be decomposed rather than left as unexplained associations between events.

The explicit treatment of PTP and TPT as complementary epistemic decompositions of a single alternating P–T–P–T causal reality is distinctive to the framework developed in these course modules. It provides a way of relating the systems-oriented input–process–output perspective to the event-oriented analysis of physical causal interaction without treating them as different kinds of causality. The further suggestion that TPT particularly supports recognition of recurring patterns of process behaviour while PTP supports logical decomposition of causal networks provides a possible link between causal representation and different forms of human causal cognition.

Practical Exercise

Return to the causal network you developed for the town experiencing local flooding after heavy rainfall.

Begin with one interaction in your network. For example, consider water moving from the surrounding land into a river. Identify the originating process, the physical transfer, and the receiving process. Represent the interaction as:

$P_1 \rightarrow T_1 \rightarrow P_2$

You have now constructed a PTP representation.

Extend the representation by considering what happens next. Identify a transfer originating from P_2 and the subsequent process upon which it acts:

$[P_1 \rightarrow T_1 \rightarrow P_2] \rightarrow [P_2 \rightarrow T_2 \rightarrow P_3]$

Identify explicitly the process shared between the two PTP units. Explain why that process can be regarded as the receiving process in one causal interaction and the originating process in the next.

Now change perspective. Choose one process within your flooding network, for example, the river reach passing through the town. Identify an important incoming transfer, the process occurring within the selected system, and an outgoing transfer:

$T_1 \rightarrow P_1 \rightarrow T_2$

Treat this as a TPT representation and describe it in ordinary systems language as:

Input → Process → Output

Extend this representation to a second process:

$[T_1 \rightarrow P_1 \rightarrow T_2] \rightarrow [T_2 \rightarrow P_2 \rightarrow T_3]$

Identify the transfer shared between the two TPT units.

Next, compare your two representations. Ask what became particularly easy to see in each. Does the PTP representation make it easier to identify physical interactions, convergence, branching or necessary causal transfers? Does the TPT representation make it easier to recognise how a system behaves when particular inputs occur and what outputs result?

Now return to the recurring relationship:

Heavy rainfall → increased river flow

Represent it first from a TPT perspective as a recurring pattern of catchment behaviour. Then begin decompressing it using PTP by identifying some of the physical processes and transfers through which rainfall eventually contributes to river flow.

Finally, write a short explanation of why PTP and TPT should not be regarded as two different kinds of causality. Explain how moving the conceptual boundary allows the same underlying causal reality to be examined from an event-based causal perspective and a systems-based process perspective, and why the two can be useful together.

Keep both representations. In the next module, Common Causal Structures, you will use the PTP perspective particularly strongly to identify recurring patterns of linear, branching, converging, cyclic, feedback and other causal organisation.