

Part V — Pattern and Judgment

Diagnosing Tangled Situations

Online, with a lab for each exercise: thinking-in-diagrams.aryehnielsen.com

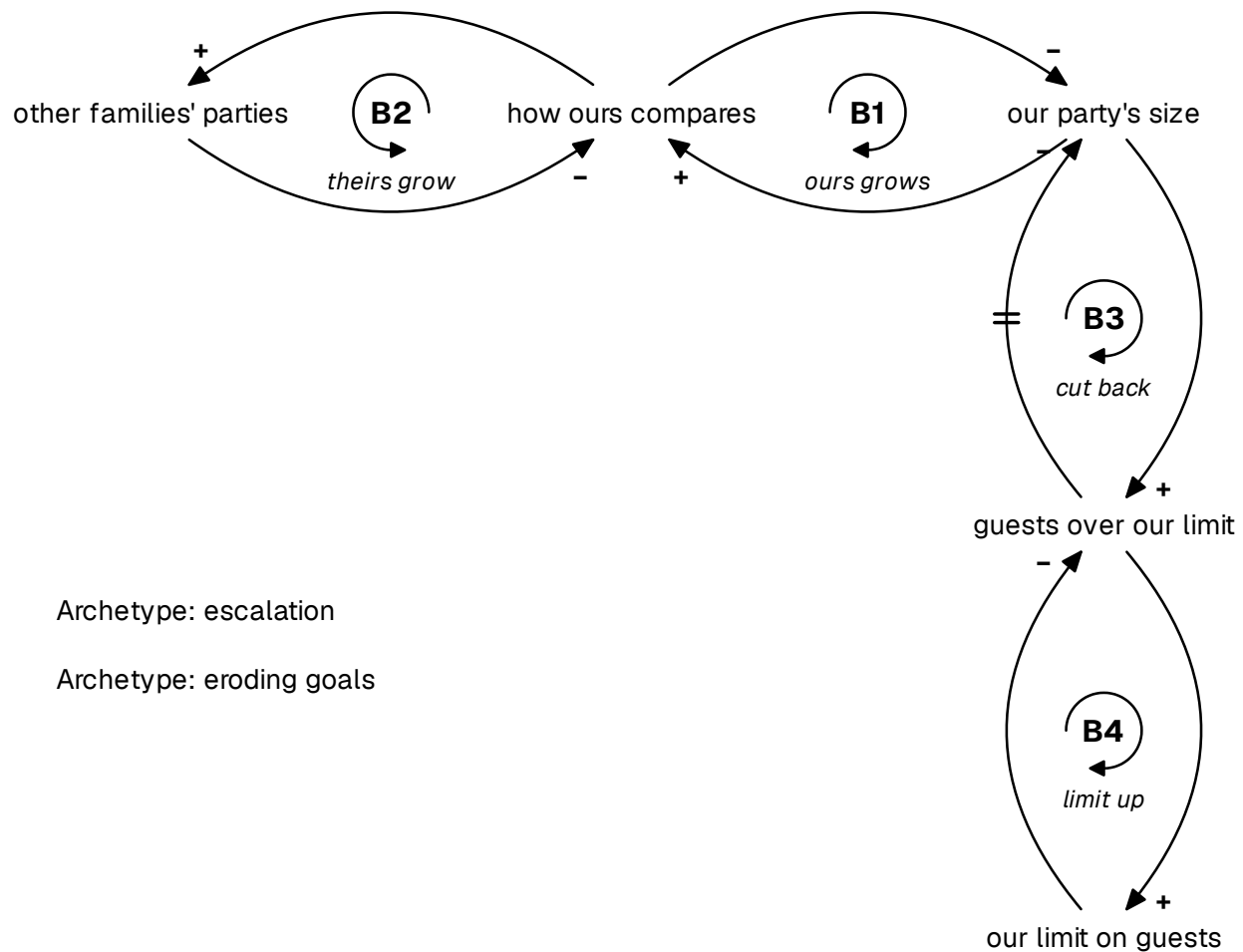
System archetypes

Part V · Pattern and Judgment · Chapter 11 of 12 · the second of two chapters on system archetypes

What if more than one story is true at once? Four more archetypes: two sides answering each other, growth short of capacity, a target that slips, partners who get in each other's way. One loop structure can be read as two of these stories, and one situation can hold two archetypes, coupled through the variables their loops share.

Birthday parties in one class

In one school class, each family holds a birthday party for its child and sets a limit on how many children it invites. Each family measures its party against the others': a party that looks small grows at the next birthday, and one that looks large makes the next family invite more. Guests over the limit are cut from the next party's list, a birthday later, or the family raises its limit toward the party it held.



B1 and B2 run through *how ours compares*, one family's party against the others': escalation. B3 and B4 run through *guests over our limit*, the party's size less the limit: eroding goals, with its delay on the cut. Both archetypes are declared, and the loops match both.

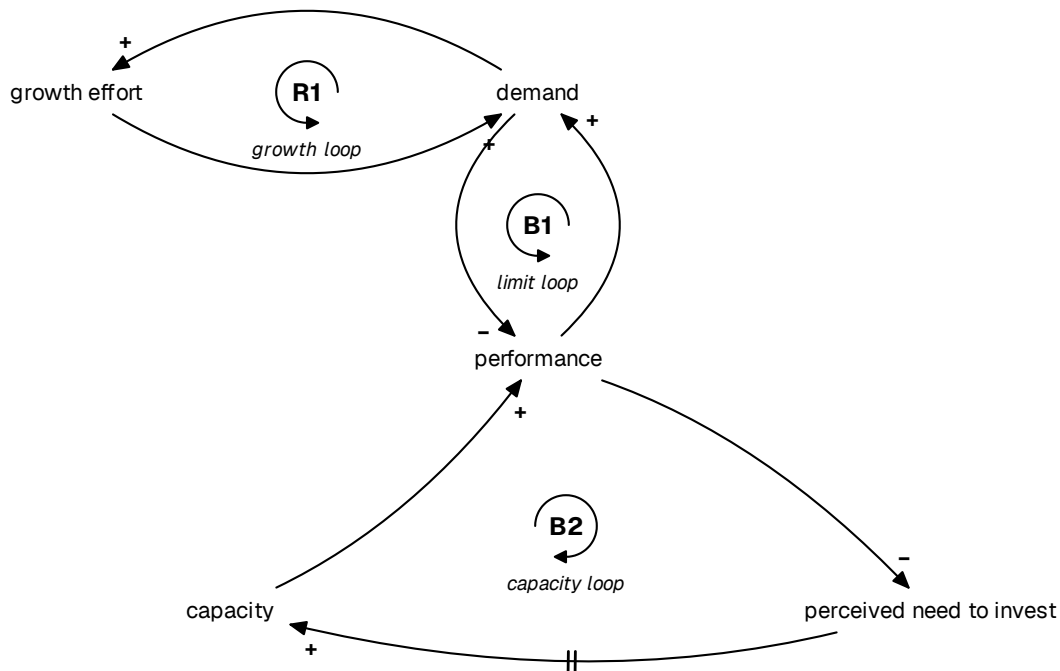
What the notation expresses

Escalation

Escalation is two sides acting on one comparison, *relative position*: A's activity raises it and B's lowers it. When it falls, A does more (B1); when it rises, B does (B2). Both loops are balancing, and together they trace a figure-8 that reinforces: each side's response is the other's reason to respond. The figure-8 passes *relative position* twice, so it is no loop of its own and carries no label. Kim notes that it takes two sides to escalate and one to stop, and asks whether the relative measure between them can change.

Growth and underinvestment

Archetype: growth and underinvestment



Growth and underinvestment is limits to growth

thinking-in-diagrams.aryehnielsen.com/pattern-and-judgment/structures-that-recur/#limits-to-growth with a third loop. Growth effort and demand raise each other (reinforcing loop R1, the growth loop) until demand lowers performance (balancing loop B1, the limit loop). Performance below the performance standard raises the perceived need to invest, which adds capacity after a delay and restores performance (B2, the capacity loop). Where the standard is lowered as performance falls, the need to invest falls too, and performance with it (Kim). Kim puts the leverage in judging capacity against demand before performance falls. The performance standard acts from outside the loops, so the template leaves it out.

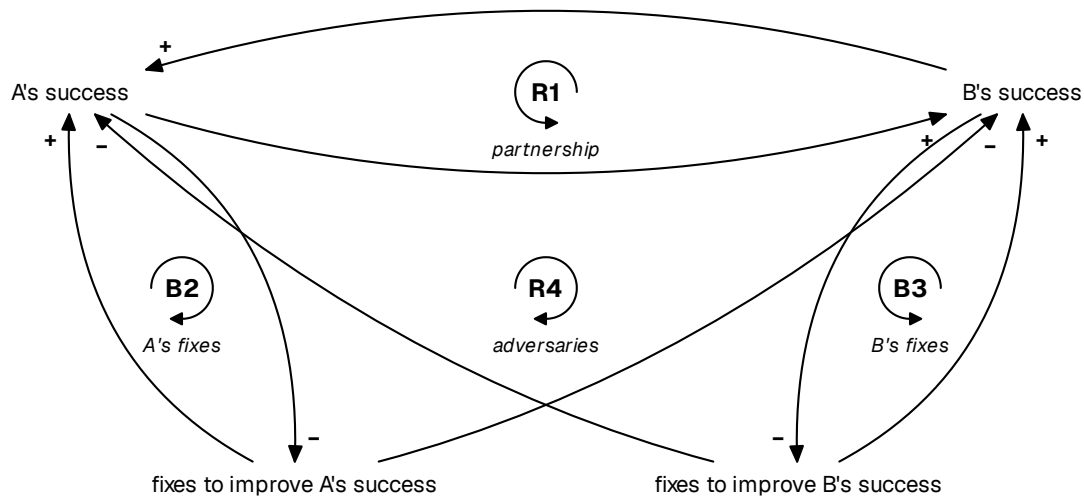
Eroding goals

In **eroding goals**, a gap between a target and actual performance closes two ways: corrective action raises actual performance, after a delay (B1), and pressure to lower the target brings the target down (B2). Kim calls eroding goals *drifting goals*. Lowering the target closes the gap at once and corrective action takes time, so B2 acts first: loop dominance thinking-in-diagrams.aryehnielsen.com/feedback/delays-drivers-and-competing-loops/#loop-dominance. Unlike chapter 8's target thinking-in-diagrams.aryehnielsen.com/control/sense-compare-correct/#target-and-gap, here the target moves: the gap lowers it. Kim finds that targets set from outside the situation drift less.

In the parties, the gap is *guests over our limit*, the party's size less the limit: named as its opposite thinking-in-diagrams.aryehnielsen.com/pattern-and-judgment/structures-that-recur/#a-variable-named-as-its-opposite, so B3's and B4's effects carry the opposite polarities and both loops stay balancing.

Accidental adversaries

Archetype: accidental adversaries

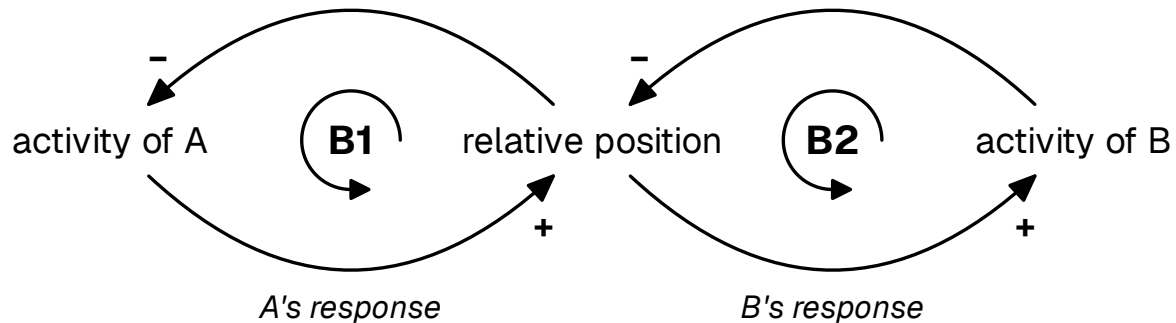


In **accidental adversaries**, two partners each raise the other's success (R1, partnership). When either is dissatisfied with its own results, it takes corrective measures alone (B2, B3) that, unseen, lower its partner's success; together the two sets of fixes close R4, the adversaries' loop. Kemeny's case, where the archetype was first recognized, is Procter & Gamble's price promotions and Walmart's stocking up on promoted goods; she puts the leverage in each partner understanding what the other needs. Each side's fixes, with the partner's success on the way back, also match fixes that fail

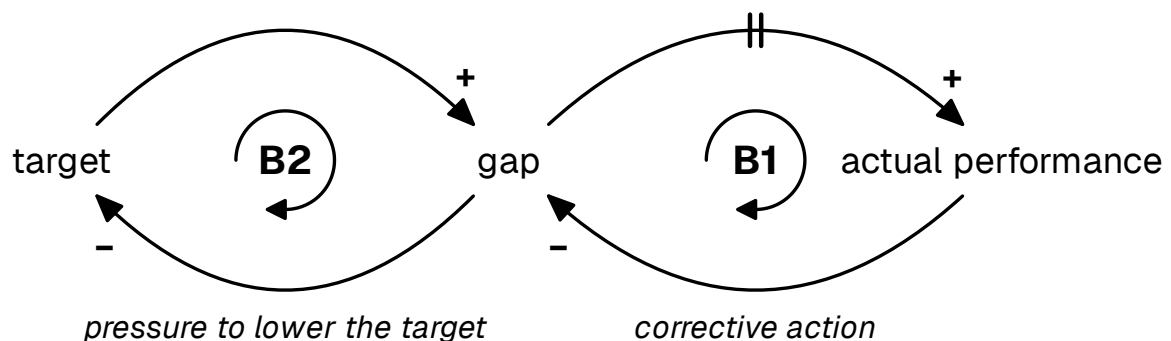
thinking-in-diagrams.aryehnielsen.com/pattern-and-judgment/structures-that-recur/#fixes-that-fail, within accidental adversaries.

One structure, two stories

Archetype: escalation



Archetype: eroding goals



Escalation and eroding goals have one shape: two balancing loops sharing one variable. Matching thinking-in-diagrams.aryehnielsen.com/pattern-and-judgment/structures-that-recur/#matching reads loops and their kinds, so every match of one is a match of the other, and the lab lists one with *Also reads as* the other. The stories differ in what the shared variable is: one side's position relative to another's, in escalation, or a gap between a target and actual performance, in eroding goals. Matching can't read that, so the loops alone don't settle which story holds; the declaration records the drawer's reading.

CHECK YOUR UNDERSTANDING

Two street musicians, Ines and Kofi, play on one corner, and each plays louder when the other drowns them out. A diagram shows Ines's volume → Ines against Kofi +, Ines against Kofi → Ines's volume -, Kofi's volume → Ines against Kofi -, and Ines against Kofi → Kofi's volume +. Its loops match escalation and eroding goals. Which story is it, and why?

- a** Escalation: the shared variable sets one musician's volume against the other's
- b** Eroding goals: Kofi's volume is the target Ines's volume closes on
- c** Either: the loops match both, so both declarations are equally right

Feedback: Answers, chapter 11

Coupled archetypes

Coupled archetypes are two matches sharing a variable: coupled loops

thinking-in-diagrams.aryehnielsen.com/feedback/loops-that-amplify-loops-that-correct/#coupled-loops, read as archetypes, so a change in one archetype's loops changes the other's. In the parties, escalation (B1, B2) and eroding goals (B3, B4) share *our party's size*: a party grown to keep up opens a gap over the limit, and a party cut back to the limit looks small again. The lab reports them coupled through *our party's size* and *how ours compares*, pairing escalation with the eroding goals that B1 and B3, two balancing loops sharing *our party's size*, also match. An external driver thinking-in-diagrams.aryehnielsen.com/feedback/delays-drivers-and-competing-loops/#external-drivers acting on both archetypes' loops doesn't couple them: it stands in for no variable of any match.

Ranking leverage

Where several leverage points

thinking-in-diagrams.aryehnielsen.com/feedback/loops-that-amplify-loops-that-correct/#leverage-points are proposed, which to try first is a ranking, written beside the diagram, in words, each leverage point with its reason. No mark ranks: every leverage point is the same box. For the parties:

1. *how ours compares*: both escalation loops pass through it, and Kim asks of escalation whether the comparison between the sides can change. A class that agrees one number of guests for every party leaves nothing to compare.
2. *our limit on guests*: held where the family set it, B4 stops, and B3 cuts each party back to it, a birthday late.

A reason resting on a dashed effect, a hypothesis in evidence coding

thinking-in-diagrams.aryehnielsen.com/feedback/delays-drivers-and-competing-loops/#evidence-coding, is a hypothesis too.

CHECK YOUR UNDERSTANDING

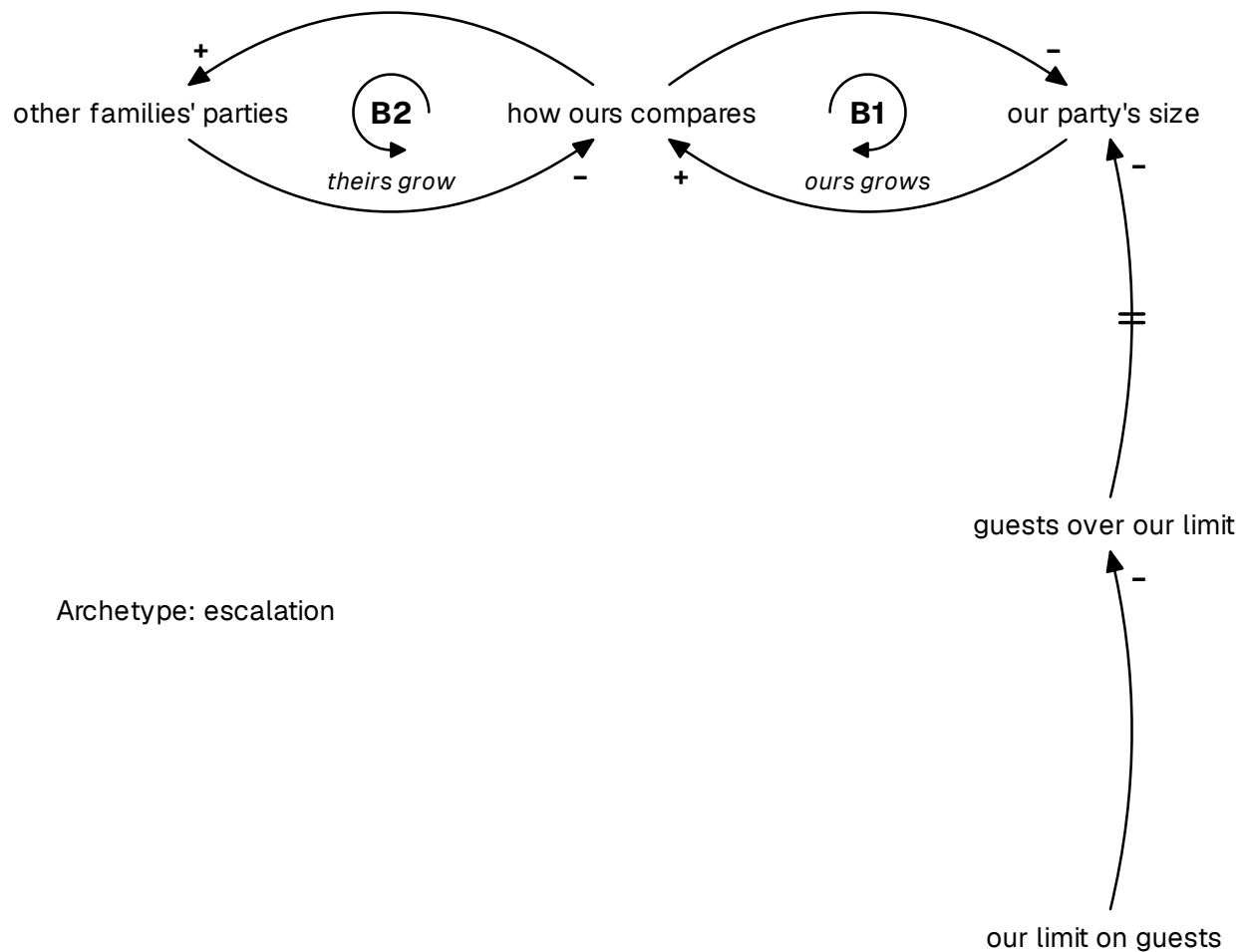
A pottery studio's evening classes fill by word of mouth, and its waiting list grows. A diagram of the studio shows two leverage points: the wheels in the studio, and the waiting list the owner treats as normal. Its author judges the waiting list the better place to act. How does the diagram show that?

- a A ranking written beside it: the waiting list first, the wheels second, each with its reason
- b A heavier box around the waiting list
- c Only the waiting list boxed, the wheels left plain

Feedback: Answers, chapter 11

The bad diagram

What's wrong with this diagram of the birthday parties?

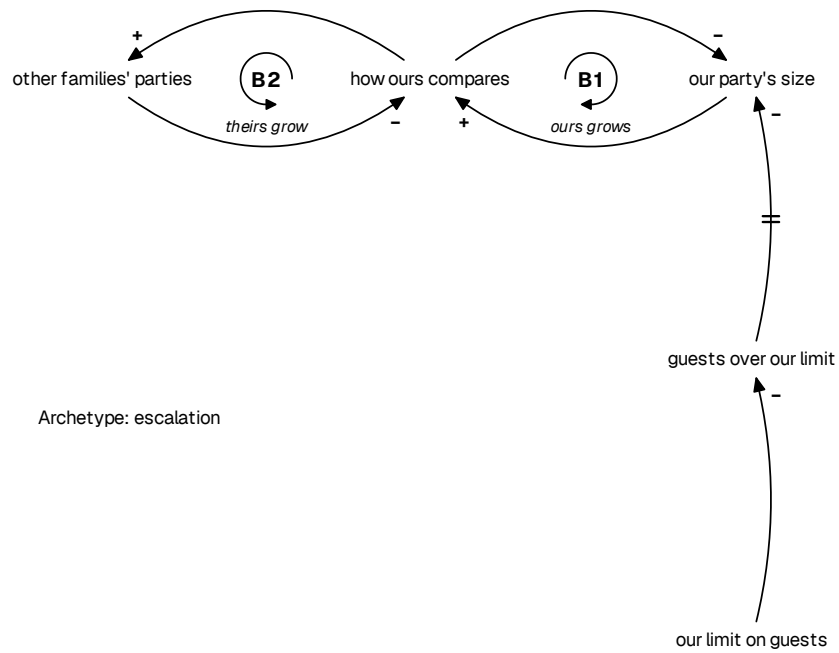
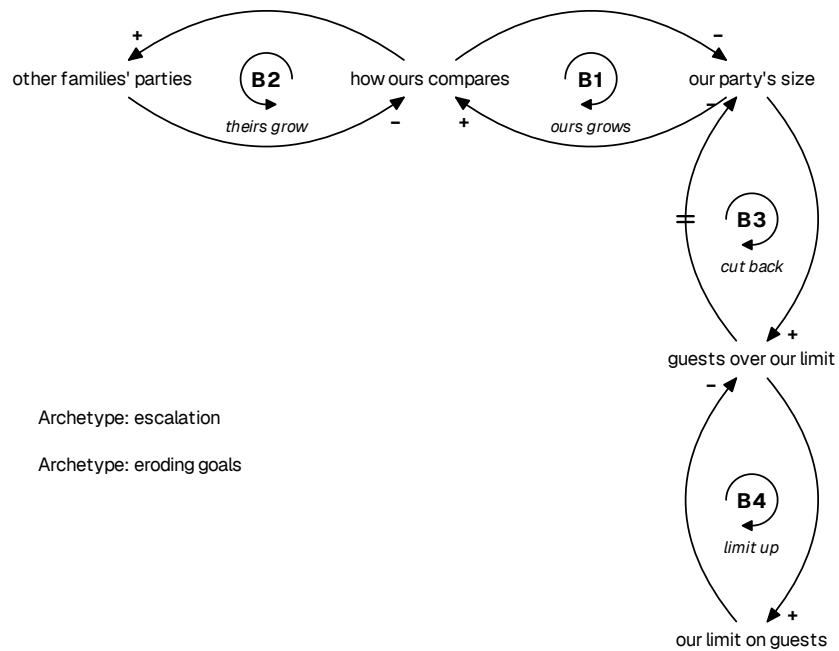


It shows the comparison alone, declared escalation. *Our limit on guests* and *guests over our limit* hold the party's size down but close no loop: the party's size never reaches *guests over our limit*, and the guests over it never move the limit. The lab's check for two coupled archetypes reports:

| 1 declared archetype. Brief: at least 2, coupled through a shared variable.

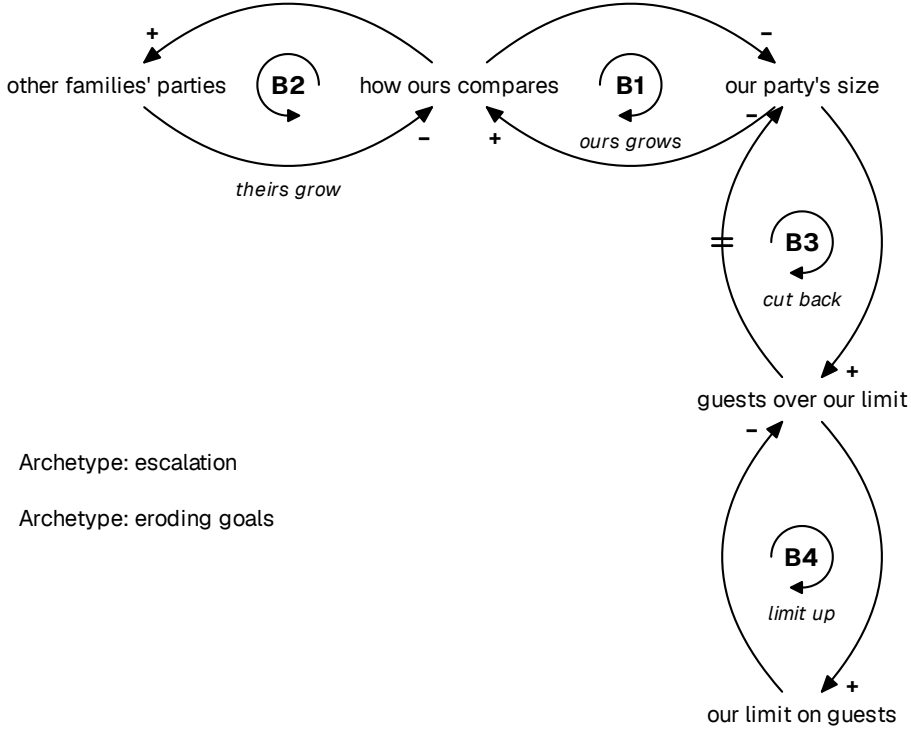
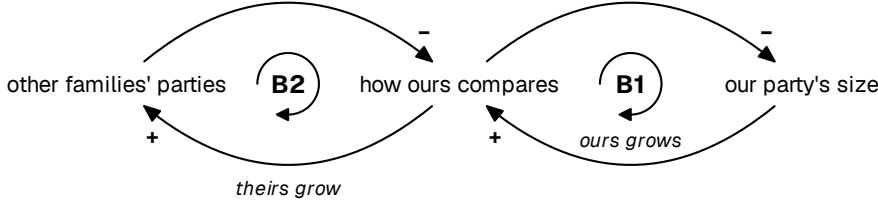
The corrected diagram

The party's size raises *guests over our limit*, closing B3, the cut, and the guests over the limit raise the limit, closing B4. Eroding goals is declared beside escalation.

Bad diagram**Corrected diagram**

Labels unchanged. Declared archetypes: eroding goals added. Effects: 2 added. Loops: 2 added. Now matched with its delay: eroding goals.

Notation moves

Notation move	When	What it shows	Example
Declare two archetypes on one diagram	Two stories run through one situation	Coupled archetypes, where their matches share a variable	<i>Archetype: escalation</i> and <i>Archetype: eroding goals</i>
 Archetype: escalation Archetype: eroding goals			
Declare escalation on two balancing loops sharing a variable	The shared variable compares two sides	The story the loops alone don't settle	<i>how ours compares</i>
 Archetype: escalation			

Notation move	When	What it shows	Example
Draw the gap as a variable between the target and actual performance	The target moves with the gap	Eroding goals' second loop	<i>guests over our limit</i>
Mark the delay on corrective action's effect	Correction arrives later than a lowered target	Which loop acts first	<i>guests over our limit</i> → <i>our party's size</i>
Mark the delay into capacity	Capacity takes time to build	Capacity arriving late	<i>need for more trains</i> → <i>trains in service</i> , in AR 07
Propose several leverage points	There is more than one place to act	Hypotheses about where to act, ranked in words beside the diagram	<i>how ours compares</i> , then <i>our limit on guests</i>

Common misreading

Read one way, a match is a diagnosis: the loops are there, so the situation is that archetype. In the parties, B1 and B2 also match eroding goals, *how ours compares* as the gap and either family's party as the target, and B3 and B4 also match escalation. The loops are the same either way; the stories differ in what the variables are. *How ours compares* sets one family's party against the others', so B1 and B2 are escalation; *guests over our limit* is a party's size less a number the family chose, so B3 and B4 are eroding goals.

The strongest objection

Archetypes fit any story told loosely enough, so naming one explains nothing. Lane (1998) divides generic structure in system dynamics into three kinds, of which the third, archetypes, involves “merely metaphorical thinking”.

The *names* are loose: escalation and eroding goals share one shape, and which one a drawing holds is the drawer’s reading, recorded in the declaration, not settled by the loops. The *structure* isn’t loose. A loop closes or doesn’t, its kind follows the parity rule

thinking-in-diagrams.aryehnielsen.com/feedback/loops-that-amplify-loops-that-correct/#the-parity-rule, a delay sits on one effect and not another, and each is checked on the drawing and can be wrong: the bad diagram’s limit closes no loop, and the lab counts one declared archetype where two coupled ones were asked for.

Check your understanding

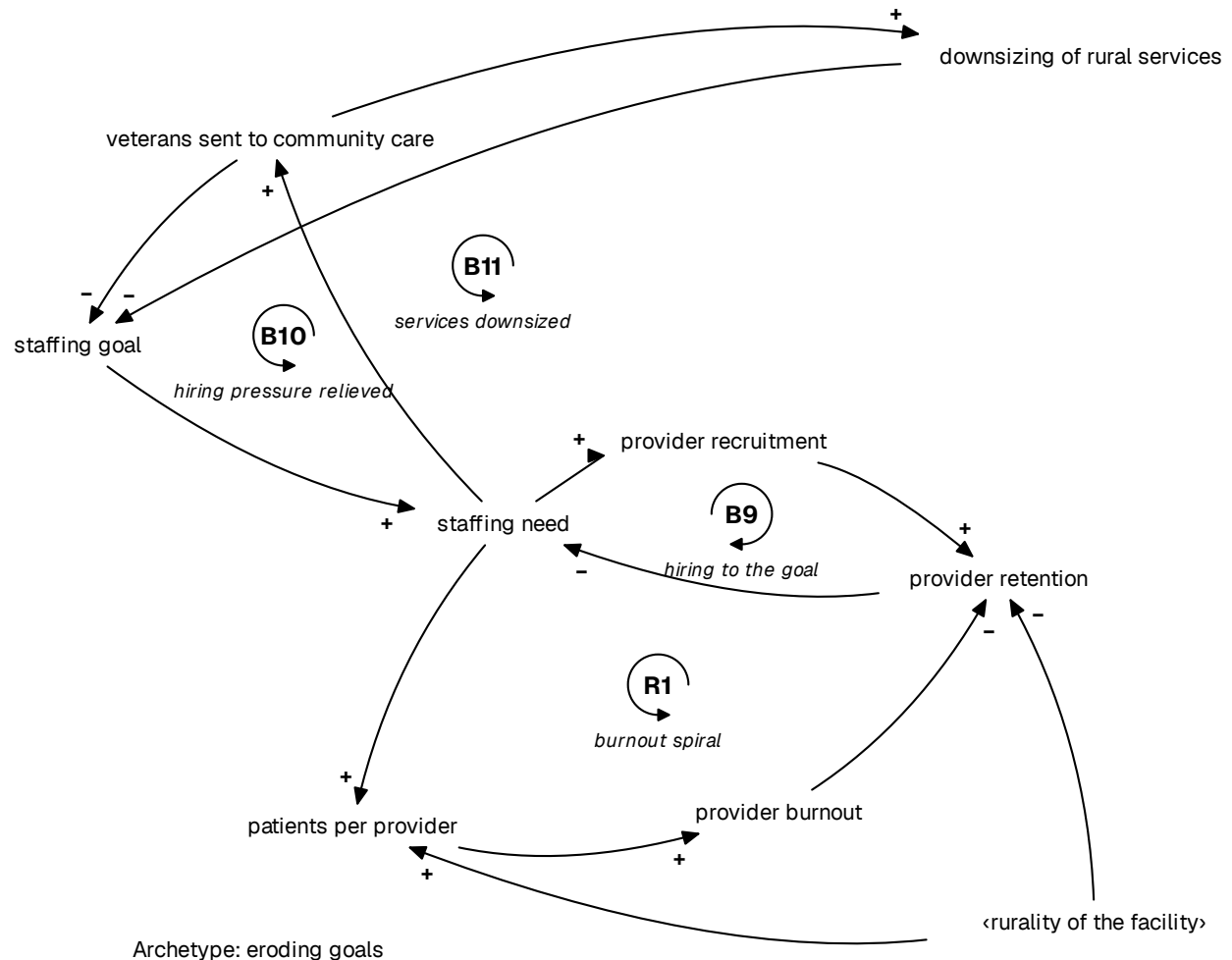
CHECK YOUR UNDERSTANDING

Sam and Jo share a flat and take turns cooking dinner for both, which leaves each of them free evenings. Short of time in the week, each starts cooking a week's lunches on Sunday afternoon. Sam's cooking takes the oven and every pan when Jo comes to cook, and Jo's leaves a sink of washing-up that Sam clears before starting. Which archetype's story is this?

- a** Accidental adversaries
- b** Escalation
- c** Fixes that fail, once for each flatmate

Feedback: Answers, chapter 11

The VA's staffing goal, redrawn



Redrawn from Erin S. Kenzie, Mary Patzel, Erik Nelson, Travis Lovejoy, Sarah Ono and Melinda M. Davis, "Long drives and red tape: mapping rural veteran access to primary care using causal-loop diagramming", BMC Health Services Research 22, 1075 (2022) doi.org/10.1186/s12913-022-08318-2, Fig. 5. CC BY 4.0 creativecommons.org/licenses/by/4.0/.

Its blue lines marked + and red lines marked – drawn alike, each polarity kept; its faded variable, provider turnover, and its line left out; VA dropped from every name; sending veterans to community care renamed as an amount, veterans sent to community care, and three other names reworded; rurality of the facility marked as an external driver; its loops' labels kept, B9 to B11 numbered as in the authors' whole model, and their names reworded by what each loop does; eroding goals, which its authors name drifting goals, declared.

QUESTION 1 OF 3

Which variable is eroding goals' target, and what brings it down?

- a Staffing need, lowered by community care.
- b Staffing goal, lowered by veterans sent to community care (B10) and by the downsizing of rural services that follows (B11).
- c Provider retention, lowered by provider burnout.

QUESTION 2 OF 3

Its authors count R1, the burnout spiral, in their drifting goals (eroding goals). With B9, R1 matches another archetype, coupled with eroding goals. Which?

- a** Shifting the burden, with community care as the symptomatic solution.
- b** Escalation, between provider recruitment and provider burnout.
- c** Fixes that fail: B9 brings retention back as the need rises, and R1 drives it down through patients per provider and burnout.

QUESTION 3 OF 3

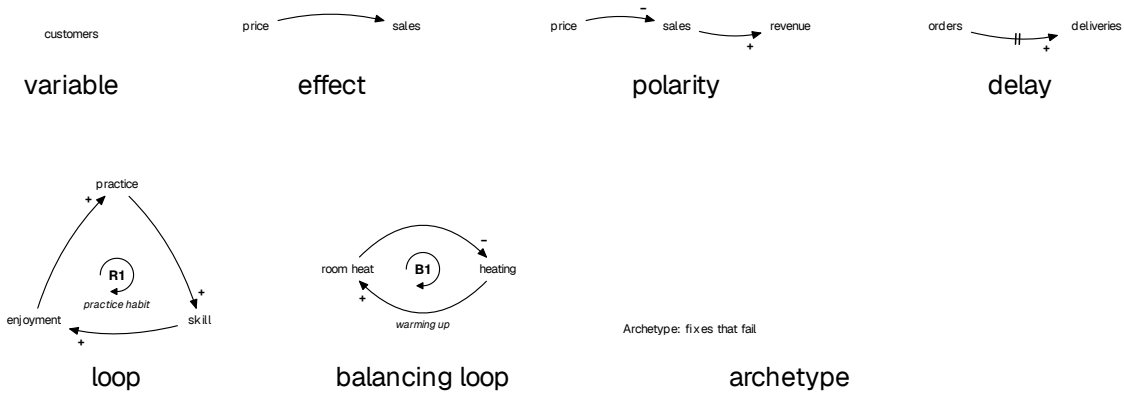
Ranked by what Kim finds of eroding goals, which leverage point comes first?

- a** Provider recruitment, pushed harder.
- b** Veterans sent to community care, cut back.
- c** The staffing goal, set from outside the facilities and held there.

Feedback: Answers, chapter 11

Exercises

Passing the checks means meeting the brief, not being right.

AR 06 An arms race between two neighboring countries**Your palette**

AR 06 An arms race between two neighboring countries

Each side's safety read against the other's

Reasoning ●●●○○ 3 of 5 Polish ●●●●○ 4 of 5

Two neighboring countries, called here North and South, each judge their safety by how their armed forces compare with the other's. North buys arms until its forces are well ahead of South's: the more arms North buys, the larger North's lead in forces, and the larger that lead, the fewer arms North buys. South buys arms while North is ahead: the more arms South buys, the smaller North's lead, and the larger North's lead, the more arms South buys. Each country pays for its arms from the budget that also pays for its schools and hospitals: the more arms either country buys, the less the two countries spend on schools and hospitals.

The brief

- ☐ Draw each country's arms purchases closing a balancing loop through one variable that compares the two countries' forces.
- ☐ The two loops match escalation.
- ☐ Draw the spending on schools and hospitals, reached from both countries' purchases.
- ☐ One variable compares the two countries' forces, and both loops pass through it.
- ☐ The spending on schools and hospitals returns to neither loop.
- ☐ The declared archetype is escalation, not eroding goals, though the same loops match both.

Your palette

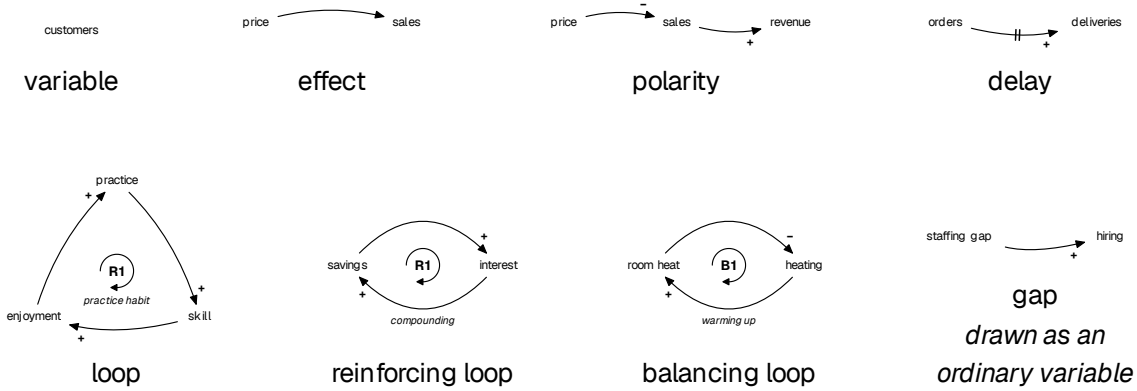
On the page before this sheet.

Draw here

Diagram drawing area with a grid of dots.

AR 07 A country's railways

Your palette



Archetype: fixes that fail

archetype

AR 07 A country's railways

Growth held back by trains never ordered

Reasoning ●●●●○ 4 of 5 Polish ●●●●○ 4 of 5

A country's railway operator draws passengers with punctual trains and cheap fares: the more passengers, the more fare offers it can pay for, and the more fare offers, the more passengers. Crowded trains wait longer at every station: the more passengers, the lower the punctuality, and the higher the punctuality, the more passengers. The operator reads its need for more trains from how far punctuality falls short of its punctuality target, once a year's figures are in: the lower the punctuality, the greater the need for more trains, after a delay, and the higher the target, the greater the need. A new train takes four years to build: the greater the need, the more trains in service, after a delay, and the more trains in service, the higher the punctuality. When the need is large, the operator lowers its target rather than order trains: the greater the need for more trains, the lower the punctuality target.

The brief

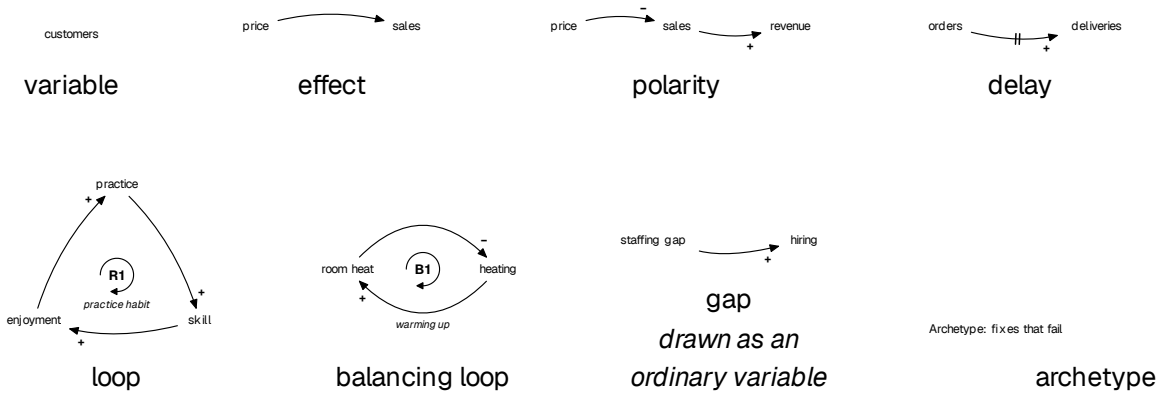
- ☐ Draw the passengers and the fare offers closing a reinforcing loop.
- ☐ Draw a balancing loop through the passengers and the punctuality, and one through the need for more trains and the trains in service.
- ☐ The loops match growth and underinvestment, with its delay where new trains arrive.
- ☐ Draw a delay where the operator reads its need for more trains, and one where new trains arrive.
- ☐ The punctuality target acts on the need for more trains, and the greater the need, the lower the target.

Your palette

On the page before this sheet.

Draw here

Diagram drawing area with a grid of dots.

AR 08 Knee exercises after an operation**Your palette**

AR 08 Knee exercises after an operation

A target that moves toward what was done

Reasoning ●●●●○ 4 of 5 Polish ●●●●○ 4 of 5

After an operation on her knee, Priya sets herself a weekly target of fifteen sessions of the exercises her physiotherapist gave her. Each Sunday she counts the sessions done that week, and the gap is the target minus the sessions done: the higher the target, the larger the gap, and the more sessions done, the smaller the gap. When the gap is large she fits extra sessions into the next week, so the gap raises the sessions done a week later: the larger the gap, the more sessions done, after a delay. On busy weeks at work she falls short, and each time she does, she sets next week's target closer to what she managed: the larger the gap, the lower the weekly target.

The brief

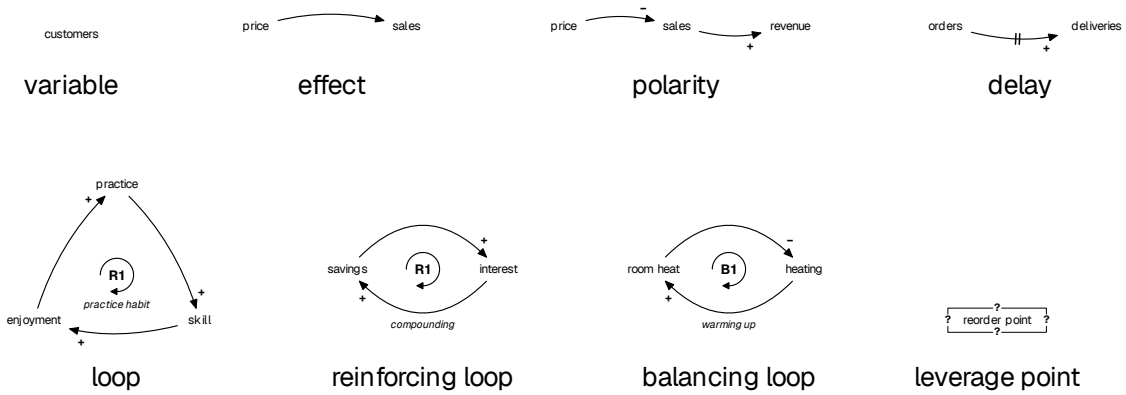
- ☐ Draw two balancing loops through the gap: one through the sessions done, one through the weekly target.
- ☐ The loops match eroding goals, with its delay on the extra sessions.
- ☐ The gap is a variable of its own: the weekly target minus the sessions done.
- ☐ The second loop is named for the lowered target, which closes the gap without a session more.

Your palette

On the page before this sheet.

Draw here

Diagram drawing area with a grid of dots.

AR 09 Two parents sharing care after a separation**Your palette**

Archetype: fixes that fail

archetype

AR 09 Two parents sharing care after a separation

Partners whose own fixes hold each other back

Reasoning ●●●●● 5 of 5 Polish ●●●●● 5 of 5

Maya and Tom separated last year and share the care of their two children, a week each. Each helps the other's weeks go well, with lifts to football and the same homework rules in both homes: the better Maya's weeks go, the better Tom's go, and the better Tom's weeks go, the better Maya's go. When a week goes badly, each makes changes alone to ease their own weeks, such as a new bedtime or a swapped weekend: the worse Maya's weeks go, the more changes she makes alone, and the more changes she makes alone, the better her weeks go; the same holds for Tom. Each one's changes reach the other's home a week or two later, with the children: the more changes Maya makes alone, the worse Tom's weeks go, after a delay, and the more changes Tom makes alone, the worse Maya's weeks go, after a delay. Both parents see how settled the children are, which rises the better either parent's weeks go.

The brief

- ☐ The loops match accidental adversaries.
- ☐ Draw a delay on each parent's changes' effect on the other's weeks.
- ☐ Mark one leverage point.
- ☐ The two delays sit where each parent's changes reach the other's weeks, not on the help each gives the other.
- ☐ The leverage point is a measure both parents can see.

Your palette

On the page before this sheet.

Draw here

AR 10 A coastal town and its sea walls

Your palette

customers

variable

price → sales

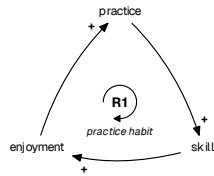
effect

price → sales → revenue
- +

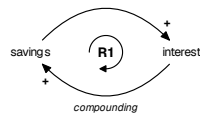
polarity

orders → deliveries
+ //

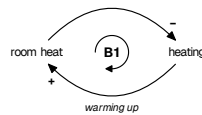
delay



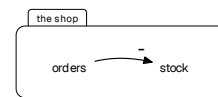
loop



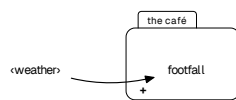
reinforcing loop



balancing loop



boundary



external driver

training → quality

evidence coding

? reorder point ?

leverage point

oscillation

behavior note

Archetype: fixes that fail

archetype

pests → symptomatic solution
spraying

symptomatic solution
a role, written above its
variable's name

pests → fundamental solution
hedgerows planted

fundamental solution
a role, written above its
variable's name

spraying → side effect
predators lost

side effect
a role, written above its
variable's name

AR 10 A coastal town and its sea walls

Two archetypes sharing one variable

Reasoning ●●●●● 5 of 5 Polish ●●●●● 5 of 5

A coastal town of eight thousand people floods when winter storms push the sea over its seafront: the more winter storms, the more flooding of the seafront. Each flood brings calls for sea walls, and a wall stops the sea at once: the more flooding of the seafront, the more sea walls built, and the more sea walls built, the less flooding. The walls stop the waves from carrying sand along the shore, so the beach in front of them thins, and years later the sea reaches the walls with more force: the more sea walls built, the more sand lost from the beach, and the more sand lost, the more flooding, after a delay. Restoring the dunes behind the beach would protect the coast for decades, though new dunes take years to grow: the more flooding, the more dune restoration, and the more dune restoration, the less flooding, after a delay. Behind each new wall, the town allows homes and shops: the more sea walls built, the more building behind the walls. The town's engineers think the new building makes dune restoration costlier, since the land behind the beach is no longer free, but they have no figures yet: the more building behind the walls, the less dune restoration.

The brief

- ☐ Declare each archetype the structure holds, at least two.
- ☐ The declared archetypes are coupled: their matches share a variable.
- ☐ Mark at least two leverage points.
- ☐ Code the effect you judge less supported as a hypothesis, declared in the legend.
- ☐ Draw at least three loops.
- ☐ Beside the diagram, rank the leverage points in a list, each with its reason.
- ☐ The winter storms sit outside a boundary named for the town's coast, and nothing inside acts on them.
- ☐ No variable is drawn twice: the sea walls built are one variable, in both archetypes.

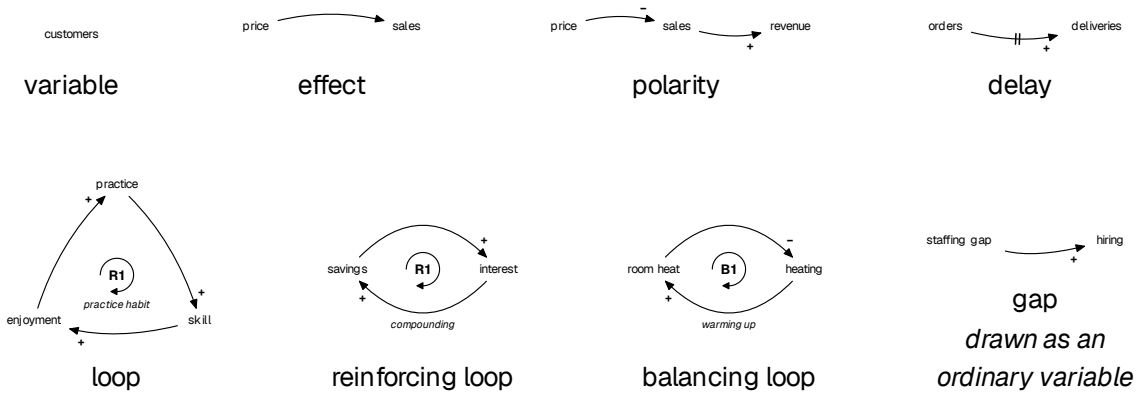
Your palette

On the page before this sheet.

Draw here

CS 11 Kelsham Primary School: the town school's pull and its rising class size

Your palette



Archetype: fixes that fail

archetype

CS 11 Kelsham Primary School: the town school's pull and its rising class size

Two archetypes coupled through one share

Reasoning ●●●●● 5 of 5 Polish ●●●●● 5 of 5

Brayford Primary School teaches each year in classes of its own, and Kelsham's families know it. The larger Brayford's share of the villages' starters, the more Kelsham children at Brayford, and the more Kelsham children at Brayford, the larger the share, as brothers, sisters and friends follow them there. The larger Brayford's share, the fewer pupils on roll at Kelsham; the fewer pupils on roll, the more mixed-age classes at Kelsham; and the more mixed-age classes, the larger Brayford's share. Helen Marsh, Brayford's head teacher, aimed for classes of 26. The more Kelsham children at Brayford, the larger its average class size, and the larger the average class size, the more pupils a class above Brayford's aim. Above its aim, Brayford offers fewer places to children from outside the town the next September: the more pupils a class above the aim, the smaller Brayford's share, a year later. Yet each year its classes run above the aim, Brayford's governors raise it, toward the most they allow, 30: the more pupils a class above the aim, the higher the class size Brayford aims for, and the higher the class size Brayford aims for, the fewer pupils a class above it.

The brief

- ☐ Draw Brayford's share of the villages' starters on two reinforcing loops that match success to the successful.
- ☐ Draw the gap between Brayford's class size and its aim on two balancing loops that match eroding goals, with its delay on the places held back.
- ☐ Declare both archetypes.
- ☐ The declared archetypes are coupled: their matches share a variable.
- ☐ Mark one delay: the September before places held back change the share.
- ☐ Brayford's share of the villages' starters is drawn once, on both archetypes' loops.
- ☐ Beside the diagram, one sentence says what each rise in Brayford's aim does to the pupils on roll at Kelsham.

Your palette

On the page before this sheet.

Draw here

Sources

- Daniel H. Kim, *Systems Archetypes I: Diagnosing Systemic Issues and Designing High-Leverage Interventions* thesystemsthinker.com/wp-content/uploads/2016/03/Systems-Archetypes-I-TRSA01_pk.pdf (Pegasus Communications, 1992, 2000): Kim's name for eroding goals, why lowering a target closes a gap sooner than corrective action, and targets set from outside, pp. 12–13; escalation, its figure-8, and the relative measure between the sides, pp. 14–15; growth and underinvestment, standards lowered as performance falls, and capacity judged against demand, pp. 6 and 18–19.
- Jennifer Kemeny, "'Accidental Adversaries': When Friends Become Foes" thesystemsthinker.com/wp-content/uploads/pdfs/050102p.pdf, *The Systems Thinker* 5, no. 1 (February 1994): 5–6, on partners whose corrective measures obstruct each other, Procter & Gamble and Walmart, and where the leverage lies.
- David C. Lane, "Can We Have Confidence in Generic Structures?" doi.org/10.1057/palgrave.jors.2600605, *Journal of the Operational Research Society* 49, no. 9 (1998): 936–947, on archetypes as metaphorical thinking (from its abstract).

Answers

Chapter 11 · Diagnosing Tangled Situations

Two street musicians, Ines and Kofi, play on one corner, and each plays louder when the other drowns them out. A diagram shows Ines's volume $\rightarrow$ Ines against Kofi +, Ines against Kofi $\rightarrow$ Ines's volume -, Kofi's volume $\rightarrow$ Ines against Kofi -, and Ines against Kofi $\rightarrow$ Kofi's volume +. Its loops match escalation and eroding goals. Which story is it, and why?

- a Escalation: the shared variable sets one musician's volume against the other's
Yes. Both archetypes are two balancing loops sharing one variable, so the loops match both. Ines against Kofi compares one side's position with the other's, as escalation's relative position does. A gap would be a target less actual performance: the volume Ines wants less Ines's volume.
- b Eroding goals: Kofi's volume is the target Ines's volume closes on
Not quite. Kofi's volume moves with the shared variable, as eroding goals' target moves with the gap, so the loops fit. But nobody chose it as a value to stay near: it is the other side's position, and that makes the story escalation.
- c Either: the loops match both, so both declarations are equally right
Not quite. The loops match both because matching reads loops and their kinds, not what a variable is. The stories differ in what the shared variable is: here it compares the two musicians, so the declaration is escalation.

A pottery studio's evening classes fill by word of mouth, and its waiting list grows. A diagram of the studio shows two leverage points: the wheels in the studio, and the waiting list the owner treats as normal. Its author judges the waiting list the better place to act. How does the diagram show that?

- a A ranking written beside it: the waiting list first, the wheels second, each with its reason
Yes. No mark ranks leverage points: each is the same box with its question marks. The order and the reasons go beside the diagram in words, where a reader can test each reason against the loops.
- b A heavier box around the waiting list
Not quite. Every mark is drawn in pencil in one weight, so a heavier box carries nothing a reader can read. A leverage point's box marks a hypothesis about where to act, not its rank.
- c Only the waiting list boxed, the wheels left plain
Not quite. That drops the second proposal, and the comparison with it. Both boxes stay, and the ranking, with its reasons, goes beside the diagram.

Sam and Jo share a flat and take turns cooking dinner for both, which leaves each of them free evenings. Short of time in the week, each starts cooking a week's lunches on Sunday afternoon. Sam's cooking takes the oven and every pan when Jo comes to cook, and Jo's leaves a sink of washing-up that Sam clears before starting. Which archetype's story is this?

- a Accidental adversaries

Yes. Their turns at cooking free each other's evenings: the partnership loop. Each Sunday's cooking eases its cook's own week, a balancing loop for each, and gets in the other's way; the two together close the adversaries' loop. Kemeny puts the leverage in each partner learning what the other needs.

- b Escalation

Not quite. Escalation's two sides act on one comparison, each against the other's lead. Neither flatmate measures their week against the other's: each Sunday's cooking is for its cook's own week, and it gets in the other's way as it goes.

- c Fixes that fail, once for each flatmate

Not quite. A drawing of the flat does match fixes that fail, one flatmate's Sunday cooking as the symptomatic solution and its side effect running through the other's week. But each such match lies within accidental adversaries, and read alone it leaves out the partnership loop that ties the two weeks together.

QUESTION 1 OF 3

Which variable is eroding goals' target, and what brings it down?

- a Staffing need, lowered by community care.

Not quite. Staffing need is the gap: the staffing goal raises it and provider retention lowers it. Community care reaches the need only by lowering the staffing goal, around B10 and B11.

- b Staffing goal, lowered by veterans sent to community care (B10) and by the downsizing of rural services that follows (B11).

Yes. A higher staffing need sends more veterans to community care, and each – effect into the staffing goal brings the goal down, closing the gap from the target's side. Here the target moves, and recruitment and retention, B9, are left less to close.

- c Provider retention, lowered by provider burnout.

Not quite. Provider retention is actual performance, the side recruitment raises through B9. Burnout lowers it around R1, but no variable sets it as a target is set.

QUESTION 2 OF 3

Its authors count R1, the burnout spiral, in their drifting goals (eroding goals). With B9, R1 matches another archetype, coupled with eroding goals. Which?

- a Shifting the burden, with community care as the symptomatic solution.

Not quite. Community care relieves the staffing need only by lowering the staffing goal, eroding goals' second loop, and R1 doesn't pass through it. No shifting the burden matches here.

- b Escalation, between provider recruitment and provider burnout.

Not quite. Escalation is two balancing loops sharing one variable, and R1 is reinforcing. The escalation that matches here is eroding goals' own shape: B9 with B10 or B11.

- c Fixes that fail: B9 brings retention back as the need rises, and R1 drives it down through patients per provider and burnout.

Yes. With provider retention named as its opposite, provider loss, as the problem symptom, B9 is the fix and R1 the side effect's loop, its delay not drawn. B9 is eroding goals' corrective action too, so the two matches share the staffing need, recruitment and retention: coupled archetypes.

QUESTION 3 OF 3

Ranked by what Kim finds of eroding goals, which leverage point comes first?

- a** Provider recruitment, pushed harder.

Not quite. Recruitment corrects through B9, after a delay, while a lowered staffing goal closes the gap at once; and R1's burnout drives out the providers recruited. While the goal can fall, a recruitment push closes the gap no sooner.

- b** Veterans sent to community care, cut back.

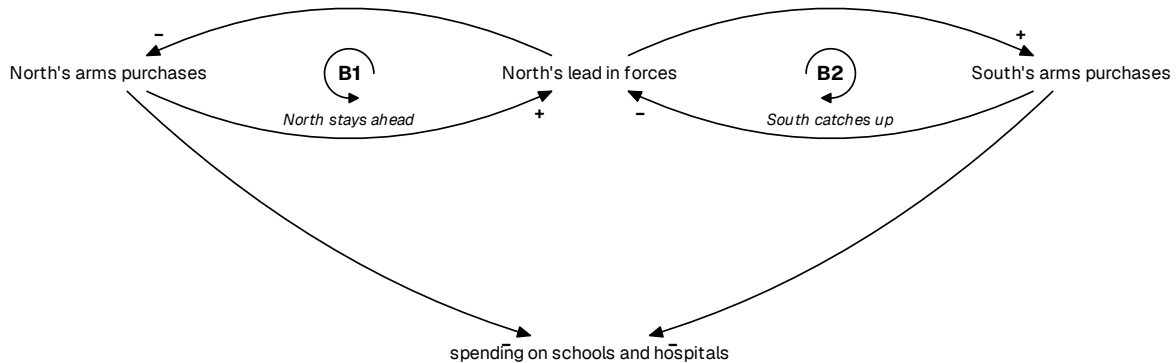
Not quite. Community care reaches veterans who would otherwise drive far for care, and it lowers the target only through its effect on the staffing goal. Holding the goal itself stops B10 and B11 with no veteran sent back to the road.

- c** The staffing goal, set from outside the facilities and held there.

Yes. Kim finds that targets set from outside the situation drift less. Held, the staffing goal no longer falls with the community care sent, so B10 and B11 stop, and the gap stays open until B9 closes it.

AR 06 An arms race between two neighboring countries

Archetype: escalation



This is one defensible answer, not the only one. Yours can differ and still hold up: the lab's checks show whether it has the brief's structure.

The more arms North buys, the larger North's lead in forces (+), and the larger that lead, the fewer arms North buys (-): one - effect, so B1 is balancing. The more arms South buys, the smaller North's lead (-), and the larger North's lead, the more arms South buys (+): B2 is balancing too. Traced as a figure 8 through both loops, each country's purchases lead to the other's: the spiral of escalation. Both countries' purchases lower the spending on schools and hospitals (-), which acts on neither loop. The declared archetype is escalation, which the structure matches; the same two loops also match eroding goals, since both archetypes are two balancing loops sharing one variable. What tells the two stories apart is what each loop changes: here each changes one country's arms, pushing the shared lead its own way; in eroding goals one loop changes what is achieved and the other lowers the target.

Why it works

- One variable, North's lead in forces, is read by both countries, so both loops pass through it
- Each loop has one - effect, so both are balancing
- The spending on schools and hospitals is reached from both countries' purchases and returns to neither loop
- The declaration names escalation, since both loops change arms and neither lowers a target

Step by step

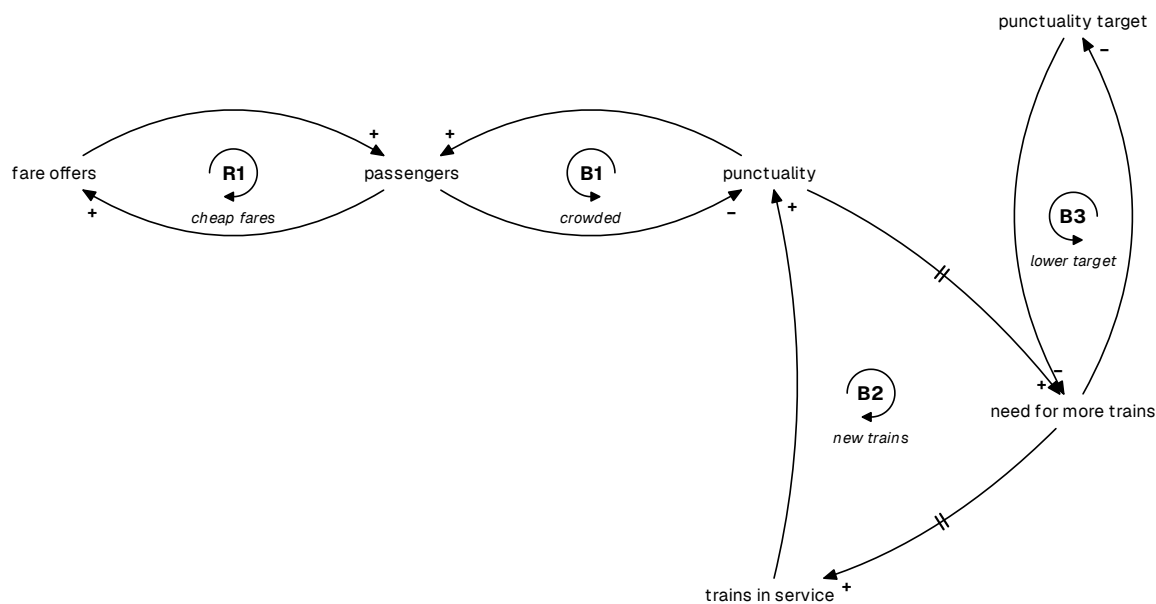
1. North's lead in forces, drawn first: each country judges its safety by it before buying anything.
2. North's arms purchases, with a + effect to the lead and a - effect back, closing B1, North stays ahead: North buys until it is well ahead.
3. South's arms purchases, with a - effect to the lead and a + effect back, closing B2, South catches up: each of South's purchases shrinks the lead that North's loop restores.
4. Spending on schools and hospitals, with a - effect from each country's purchases, drawn after both loops: it comes out of the same budgets and changes no purchase.
5. Escalation, declared last, once both countries' loops are drawn: with North's alone, there is no one to escalate against.

What another defensible answer might vary

Another defensible answer might name the comparison South's lead in forces, with the polarity of each effect into and out of it reversed: both loops stay balancing, and the match holds. Or it might draw a delay on each country's purchases, since arms take years to arrive. What stays the same is one comparison read by both countries, two balancing loops through it, and the spending on schools and hospitals outside both.

AR 07 A country's railways

Archetype: growth and underinvestment



This is one defensible answer, not the only one. Yours can differ and still hold up: the lab's checks show whether it has the brief's structure.

The more passengers, the more fare offers (+), and the more fare offers, the more passengers (+): no – effect, so R1 is reinforcing. The more passengers, the lower the punctuality (–), and the higher the punctuality, the more passengers (+): one – effect, so B1 is balancing. The lower the punctuality, the greater the need for more trains (–, with a delay); the greater the need, the more trains in service (+, with a delay); and the more trains in service, the higher the punctuality (+): B2 is balancing. The higher the target, the greater the need (+), and the greater the need, the lower the target (–): B3 is balancing. The declared archetype is growth and underinvestment, which the structure matches with its delay, and limits to growth sits within it: R1 held back by B1. B3 and B2 also match eroding goals, with the need for more trains as the gap: each time the target is lowered, the need it reads is smaller, and fewer trains are ordered.

Why it works

- R1, B1 and B2 meet at the passengers and the punctuality, as growth and underinvestment's three loops do
- One delay sits where the operator reads the need, the other where new trains arrive
- The punctuality target acts on the need for more trains, and B3 lowers it as the need grows
- Each loop's kind follows its count of – effects

Step by step

1. Passengers and fare offers, with a + effect each way, closing R1, cheap fares: the growth the operator starts from.
2. Punctuality, with a – effect from the passengers and a + effect back, closing B1, crowded: crowding holds the growth back before any train is ordered.
3. Need for more trains and trains in service, with a delay where the year's figures come in and another for the four years a train takes to build, closing B2, new trains.

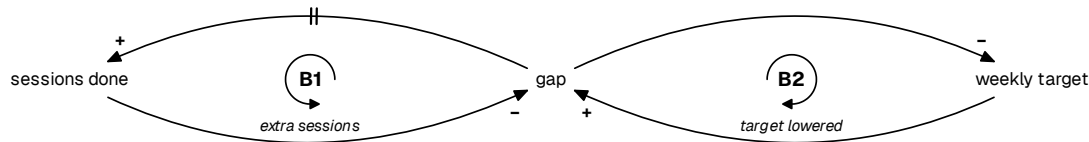
4. Punctuality target, with a + effect on the need and a – effect back, closing B3, lower target: drawn after B2, as the operator lowers the target only when the need is already large.
5. Growth and underinvestment, declared last: its template's three loops are R1, B1 and B2, and its delay is the four years of building, not the year of figures.

What another defensible answer might vary

Another defensible answer might draw the target's effect on the need through a gap, punctuality target → punctuality below the target → need for more trains, or name the punctuality as the lateness of trains, with the polarity of each effect into and out of it reversed: every loop keeps its kind, and the match holds. What stays the same is a reinforcing loop of passengers, two balancing loops meeting at the punctuality, two delays, and the target acting on the need.

AR 08 Knee exercises after an operation

Archetype: eroding goals



This is one defensible answer, not the only one. Yours can differ and still hold up: the lab's checks show whether it has the brief's structure.

The larger the gap, the more sessions done a week later (+, with a delay), and the more sessions done, the smaller the gap (–): one – effect, so B1 is balancing. The larger the gap, the lower the weekly target (–), and the higher the target, the larger the gap (+): B2 is balancing too. Both close the gap: B1 by raising the sessions done a week later, B2 by lowering the target as soon as it is reset. The declared archetype is eroding goals, which the structure matches with its delay. In the match, the weekly target and the sessions done are interchangeable: swapped, every loop keeps its kind, so the loops alone don't settle which is the target; only the target is set by Priya each Sunday.

Why it works

- The gap is a variable of its own, between the weekly target and the sessions done
- Each loop has one – effect, so both are balancing
- The delay sits on the gap's effect on the sessions done, where extra sessions wait for the next week
- B2 is named target lowered: the gap closes without more sessions

Step by step

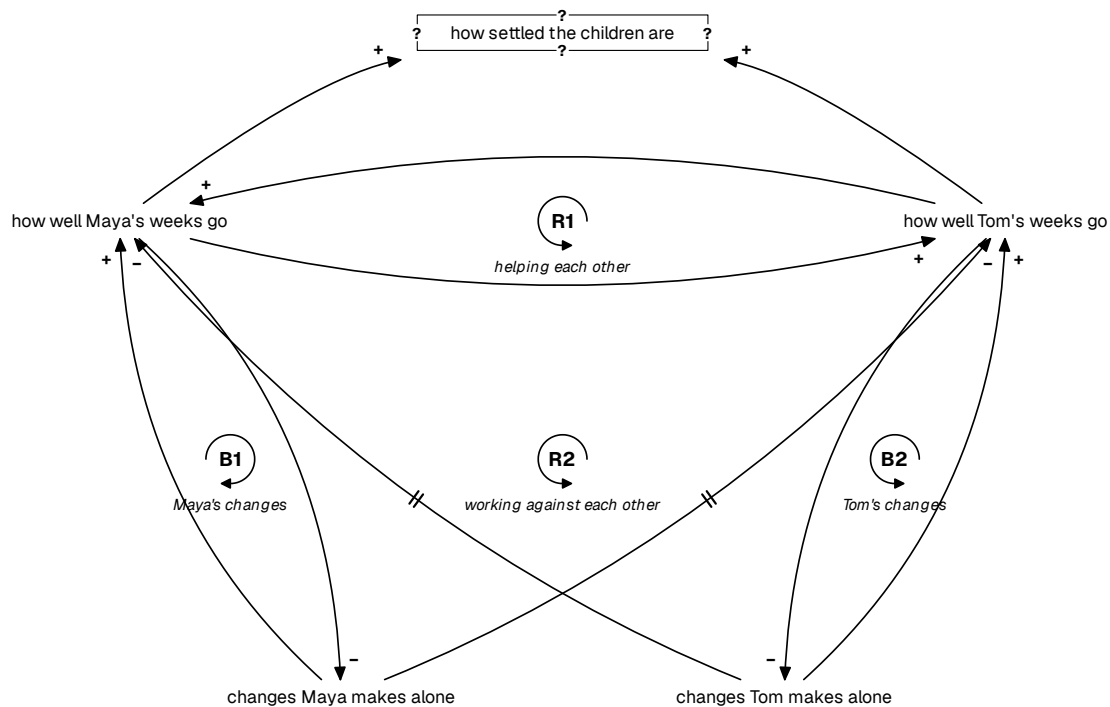
1. Weekly target, sessions done and the gap, with a + effect from the target and a – effect from the sessions: Priya's count each Sunday, before she acts on it.
2. A + effect from the gap to the sessions done, delayed by the week before extra sessions fit in, closing B1, extra sessions.
3. A – effect from the gap to the weekly target, closing B2, target lowered: drawn after B1, as Priya lowers her target only after a busy week when she falls short.
4. Eroding goals, declared last: B1 alone is a target worked toward, and B2's lowered target is what makes it erode.

What another defensible answer might vary

Another defensible answer might name the sessions done as the sessions skipped, with the polarity of each effect into and out of it reversed: both loops stay balancing, and the match holds. Or it might draw extra sessions planned between the gap and the sessions done, as a chain of two effects with the delay on either. What stays the same is one gap between the target and the sessions done, two balancing loops through it, and the delay on the loop through the sessions done.

AR 09 Two parents sharing care after a separation

Archetype: accidental adversaries



This is one defensible answer, not the only one. Yours can differ and still hold up: the lab's checks show whether it has the brief's structure.

The better Maya's weeks go, the better Tom's (+), and the better Tom's, the better Maya's (+): R1 is reinforcing. The worse Maya's weeks go, the more changes she makes alone (-), and the more changes, the better her weeks go (+): one - effect, so B1 is balancing, and B2 is Tom's. Each parent's changes make the other's weeks worse, after a delay (-): R2 runs from Maya's weeks through her changes, Tom's weeks and his changes back to Maya's weeks, with four - effects, so it is reinforcing. The declared archetype is accidental adversaries, which the structure matches: each parent's changes ease their own weeks at once and, weeks later, the other's get worse, which brings on the other's changes. How settled the children are, reached from both parents' weeks, is the leverage point: it is the one measure both parents see, and a change that eases one home and unsettles the other shows in it.

Why it works

- R1, the help each parent gives the other, and R2, their changes working against each other, both pass through both parents' weeks
- B1 and B2 are each parent's changes, easing their own weeks
- The delays sit on the effects from each parent's changes to the other's weeks, where the children carry them between homes
- The leverage point is how settled the children are, a measure both parents see

Step by step

1. How well Maya's and Tom's weeks go, with a + effect each way, closing R1, helping each other: the lifts to football and the shared homework rules the situation starts with.

2. Changes Maya makes alone, with a – effect from her weeks and a + effect back, closing B1, Maya's changes: a new bedtime that eases her own week.
3. Changes Tom makes alone, with the same two effects on his side, closing B2, Tom's changes: a swapped weekend that eases his.
4. A – effect from each parent's changes to the other's weeks, each delayed by the week or two before the children bring them over, closing R2, working against each other.
5. How settled the children are, the leverage point, with a + effect from each parent's weeks: drawn last of the variables, as it is reached from both homes and acts on neither loop.
6. Accidental adversaries, declared last, once R2, the loop the delayed effects close, is drawn.

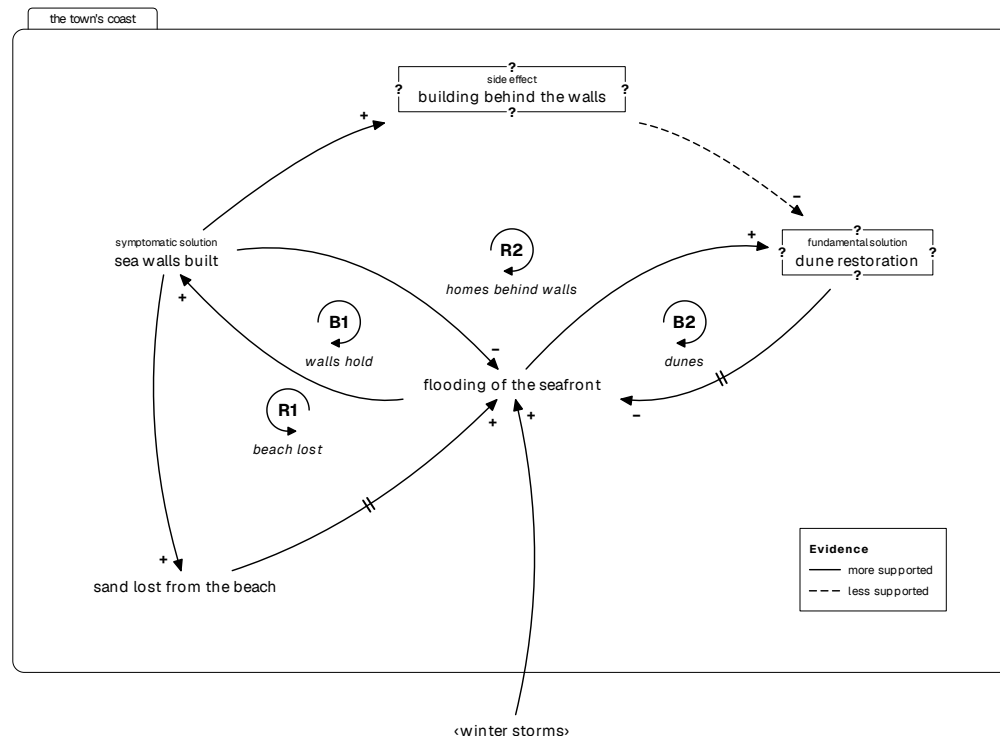
What another defensible answer might vary

Another defensible answer might draw the two further loops the structure holds, Maya's changes worsening Tom's weeks and so the help he gives her (and Tom's likewise), each reinforcing, or name each parent's weeks as how hard they go, with the polarity of each effect into and out of them reversed: every loop keeps its kind, and the match holds. It might also mark the leverage point on a shared calendar of both homes' rules, drawn as a variable acting on both parents' changes. What stays the same is the help between the two parents' weeks, each parent's changes easing their own weeks, those changes reaching the other's weeks after a delay, and one leverage point.

AR 10 A coastal town and its sea walls

Archetype: fixes that fail

Archetype: shifting the burden



This is one defensible answer, not the only one. Yours can differ and still hold up: the lab's checks show whether it has the brief's structure.

Winter storms, outside the town's coast, raise the flooding of the seafront (+). The more flooding, the more sea walls built (+), and the more walls, the less flooding (-): one - effect, so B1 is balancing. The more walls, the more sand lost from the beach (+), and the more sand lost, the more flooding, years later (+, with a delay): R1 runs from the flooding through the walls and the sand back to the flooding with no - effect, so it is reinforcing. The more flooding, the more dune restoration (+), and the more restoration, the less flooding, after a delay (-): B2 is balancing. The more walls, the more building behind them (+), and the more building, the less dune restoration (-, coded as a hypothesis): R2 runs from the flooding through the walls, the building and the restoration back to the flooding, with two - effects, so it is reinforcing. B1 and R1 match fixes that fail, with its delay; B1, B2 and R2 match shifting the burden, with its delay. The two archetypes are coupled through the sea walls built and the flooding of the seafront: each wall relieves the flooding at once, loses sand from the beach, and makes the restoration that would last for decades costlier.

Why it works

- The sea walls built are one variable, the symptomatic solution in both archetypes, which share it and the flooding
- The delays sit where the lost sand brings flooding back and where restored dunes lower it, years after each change
- The building's effect on dune restoration is dashed, and the legend shows the coding
- The winter storms act on the flooding from outside the town's coast, and nothing inside acts on them

- Leverage, ranked first: dune restoration, the fundamental solution, which lowers the flooding without losing sand from the beach; its delay of years means it starts long before the flooding it prevents
- Ranked second: building behind the walls, whose limit keeps dune restoration affordable and weakens R2
- The sea walls built are no leverage point: each wall adds to both R1 and R2

Step by step

1. The town's coast as a boundary, the flooding of the seafront inside it and winter storms outside, with a + effect: the situation opens with the storms that flood the town.
2. Sea walls built, the symptomatic solution, with a + effect from the flooding and a – effect back, closing B1, walls hold: a wall stops the sea at once.
3. Sand lost from the beach, with a + effect from the walls and a + effect to the flooding, delayed by the years before the sea reaches the walls with more force, closing R1, beach lost.
4. Dune restoration, the fundamental solution and a leverage point, with a + effect from the flooding and a – effect back, delayed by the years new dunes take to grow, closing B2, dunes.
5. Building behind the walls, the side effect and the other leverage point, with a + effect from the walls and a dashed – effect, the engineers' hypothesis, to the dune restoration, closing R2, homes behind walls, with the legend for the dashed line.
6. Fixes that fail and shifting the burden, declared last: B1 and R1 matched fixes that fail from step 3, and shifting the burden matched only once B2 and R2 were drawn.

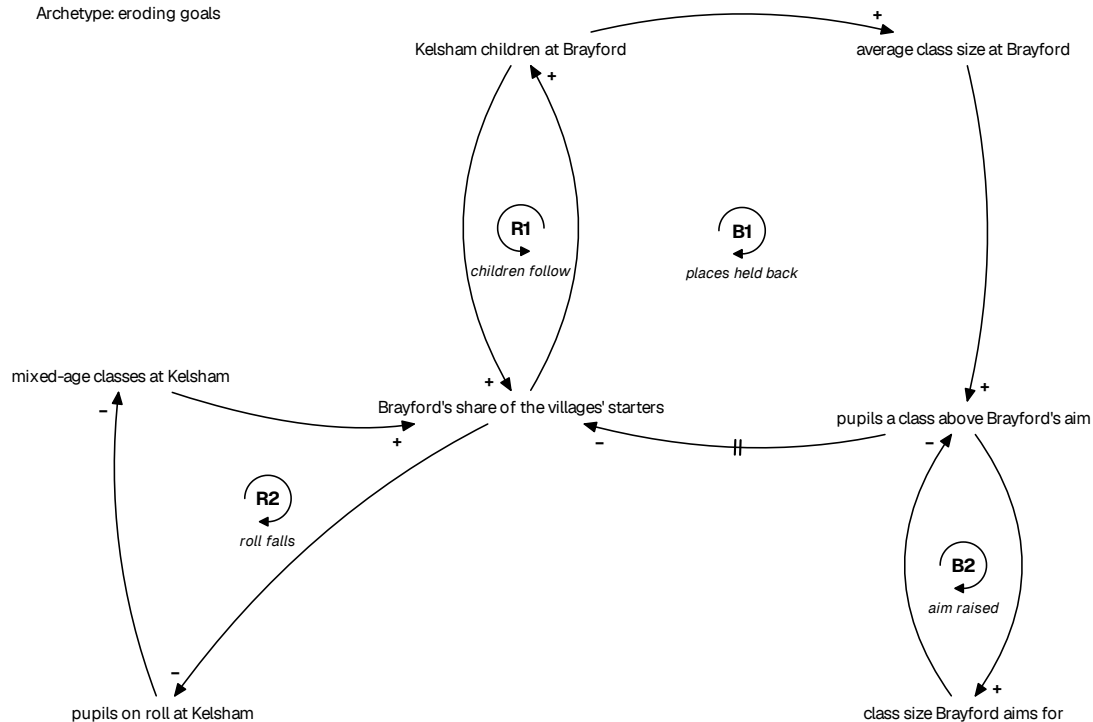
What another defensible answer might vary

Another defensible answer might name the sand lost as the sand on the beach, with the polarity of each effect into and out of it reversed: every loop keeps its kind, and both matches hold. Or it might draw rising sea level beside the winter storms, a second external driver acting on the flooding, or mark the sand lost from the beach as the side effect of fixes that fail. What stays the same is one variable for the sea walls built, shared by both archetypes, the two delays, the building's effect on the restoration coded as a hypothesis, and a ranking written beside the diagram, not drawn.

CS 11 Kelsham Primary School: the town school's pull and its rising class size

Archetype: success to the successful

Archetype: eroding goals



This is one defensible answer, not the only one. Yours can differ and still hold up: the lab's checks show whether it has the brief's structure.

Brayford's share of the villages' starters sits on three of the four loops. The larger the share, the more Kelsham children at Brayford (+), and the more of them, the larger the share (+): R1 is reinforcing. The larger the share, the fewer pupils on roll at Kelsham (-), the more mixed-age classes there (-), and the larger the share (+): two – effects, so R2 is reinforcing too. R1 and R2 match success to the successful, the share as the allocation: Brayford gains what Kelsham loses. The more Kelsham children at Brayford, the larger its average class size (+) and the more pupils a class above its aim (+), which holds places back the next September (-, with a delay): one – effect, so B1 is balancing. The more pupils above the aim, the higher the aim (+), and the higher the aim, the fewer pupils above it (-): B2 is balancing. B1 and B2 match eroding goals with its delay. The two archetypes are coupled through the share and the Kelsham children at Brayford: each rise in the aim closes the gap before B1 holds places back, so the share goes on growing and the pupils on roll at Kelsham go on falling.

Why it works

- Brayford's share of the villages' starters is one variable: the allocation in success to the successful, and on B1's path from the gap to the class size
- R2 has two – effects, an even number, so it is reinforcing
- The gap is a variable of its own, between Brayford's average class size and its aim, named by the pupils above the aim
- The delay sits on the gap's effect on the share: places are held back only from the next September
- B2 is named aim raised: the gap closes without a place held back
- Each rise in the aim lets Brayford take more of the villages' starters, so the pupils on roll at Kelsham fall faster

Step by step

1. Brayford's share of the villages' starters, drawn first: three of the four loops pass through it.
2. Kelsham children at Brayford, with a + effect from the share and a + effect back, closing R1, children follow: brothers, sisters and friends follow the children already there.
3. Pupils on roll at Kelsham and mixed-age classes at Kelsham, with a – effect from the share, a – effect between them and a + effect back to the share, closing R2, roll falls: Brayford's gain seen from Kelsham's side.
4. Average class size at Brayford, with a + effect from the Kelsham children there, then the class size Brayford aims for and the gap, with a + effect from the class size and a – effect from the aim: Brayford compares the two before it acts.
5. A – effect from the gap to the share, delayed until the next September, when places are held back, closing B1, places held back.
6. A + effect from the gap to the aim, closing B2, aim raised: drawn after B1, since the governors raise the aim only after a year above it.
7. Success to the successful and eroding goals, declared last: the first matched from step 3, the second only once B2 was drawn, coupled through the share and the Kelsham children at Brayford.

What another defensible answer might vary

Another defensible answer might name the gap the places left in Brayford's classes, with the polarity of each effect into and out of it reversed: both balancing loops keep their kinds, and the match holds. Or it might draw Kelsham's share of the villages' starters in place of Brayford's, which reverses the polarity of each effect into and out of it and leaves all four loops' kinds as they are. What stays the same is one share on both archetypes, two reinforcing loops through it, two balancing loops through the gap, and the delay on the places held back.