

Process tracing with Bayesian updating

Better Evidence in Action

In brief

Process tracing and Bayesian updating is a quali-quantitative methodology that uses probative confidence updating to assess the strength of the evidence for a specified story of change or causal mechanism. We can use the method to investigate outcomes that are already known and to measure impacts at macro and micro levels. Process tracing is applied widely in political science, psychology and history studies. This method can tell us how and why a specific cause produced a particular effect, but it cannot estimate the net effect of an intervention.

Bayesian updating measures our confidence in the steps of the causal mechanism by assessing their probative value according to:

- Sensitivity: the probability of observing the piece of evidence if the step in the causal mechanism is true
- Specificity (and type I error): the probability of observing the same piece of evidence if the step in the causal mechanism is false.

Once we have identified the different actors and characterised the key activities or steps of the causal mechanism, we can apply Bayesian updating to establish the probabilities of each step taking place before gathering evidence (the prior probability) and subsequently after considering the empirical observations (posterior probability). Calculating the posterior probability using Bayes' formula gives us a numerical value (see Table 1) to assess the confidence we have in each component of a causal mechanism contributing to the process.

Process tracing enquiries can be inductive or deductive. An inductive enquiry uses evidence to generate a causal mechanism to explain the outcome and generate additional or alternative explanations. A deductive enquiry aims to test a theory on a causal mechanism by examining whether it can explain the evidence for how an outcome occurred.

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Table 1. Bayesian updating: numeric confidence levels

Practical certainty	0.99+
Reasonable certainty	0.95–0.99
High confidence	0.85–0.95
Cautious confidence	0.70–0.85
More confident than not	0.50–0.70
No information	0.50

Source: Befani and Stedman-Bryce (2016)

When can we use it?

Process tracing with Bayesian updating is particularly useful for investigating how and why a particular change or impact has come about. We can use it to gain insight into causal mechanisms (to find out how change has happened), to evaluate prior hypotheses (to find out why change has happened), and to discover and assess new and/or alternative hypotheses. It essentially gives us a story to explain how change happened, with details of the actors involved and the activities they undertook to influence change.

Strengths for gathering better evidence

The key strength of process tracing is its use of many different information types, including (but not limited to) interview transcripts, public speeches, meeting minutes, internal documents, memoirs and email exchanges. And there are no restrictions on the types of evidence we can use, so we can include less traditional forms such as pictures or GIS maps.

Process tracing is clearly communicable to multiple stakeholders, including local stakeholders, as it is essentially a story of the most plausible pathway to change. The Bayesian updating component is less easy to communicate or explain to local stakeholders, but it provides valuable information for policymakers and funders.

This approach encourages us to interrogate the perceived wisdom of our contribution claim(s) and investigate possible alternative explanations for why change occurred. The latter can either be mutually exclusive or complementary to the former. A strong process tracing enquiry will give equal attention to examining our own contribution claim(s) and plausible alternative explanations.

Because Bayesian updating assigns a probative value to each component of a contribution claim, based on the strength of the evidence, we cannot over-exaggerate impact due to high confidence in one or two aspects of the causal mechanism. When we calculate the overall probative value for a contribution claim, it can only be equal to its weakest component. So, one component with a low probative value will affect the probative value of the overall contribution claim.

The method makes a clear distinction between absence of evidence and evidence of absence. Absence of evidence has little inferential value; on the other hand, evidence of absence can challenge a contribution claim. With a causal mechanism, there are certain pieces of evidence we might expect to see if the contribution claim were to hold true. So, where evidence of absence contradicts these expectations, it can call into question a step of the causal mechanism or indeed the mechanism as a whole.



Fieldwork with people local to Bwindi Impenetrable National Park, Uganda

Credit: Mahboobeh Shirshorshidi

Because it makes us proactively look for alternative and/or additional explanations for an outcome, process tracing has a high level of internal validity. Contribution claim(s) transparently detail our research hypothesis, which we sub-divide into necessary components or steps. Bayesian updating strengthens this transparency by declaring our assumptions and confidence in the existence of the contribution claim when we consider the evidence. By increasing the transparency of the qualitative data collection and analysis, it increases the enquiry's credibility.

Aspects to keep in mind

Process tracing with Bayesian updating is a mostly backward-looking methodology. It is not forward-looking or action-oriented. Starting with either a theory or evidence, this analytical tool helps us unpack how and why a specific outcome occurred.

The results of such an evaluation are often site- and context-specific, and focus on the most plausible story of how and why a particular change occurred, given the evidence. While some aspects of a causal mechanism developed through this method could be generalisable and provide lessons for policy and/or practice at local, national or global levels, in terms of external validity we should be cautious about drawing any such generalisations. However, process tracing can suggest what is more or less likely to work in other circumstances, if the study or evaluation is complemented by thorough literature review and rigorous comparative analysis against similar cases.

Considering power, inequality and gender

Where possible and appropriate, process tracing methodology should incorporate multiple viewpoints and data sources from a range of stakeholders. This can include the perspectives of: the powerful and not so powerful, women and men, and those who face inequality.

Understanding and probing around power, inequality and/or gender could reveal significant, and often overlooked, insights into how change occurred in a specific case. To ensure that we systematically incorporate issues of power, inequality and gender, we could use stakeholder analysis or power mapping to guide our process tracing inquiries.

Process tracing with Bayesian updating in action

In 2016, IIED used process tracing and Bayesian updating to assess a micro-level impact of the 'Research to policy: building capacity for conservation through poverty alleviation' project in Uganda, funded by the UK government's Darwin Initiative from 2012 to 2015.

We set out to understand the role our project partner — the Ugandan Poverty and Conservation Learning Group (UPCLG) — played in influencing a policy change by the Uganda Wildlife Authority (UWA) in July 2015 that increased the community share of the US\$600 gorilla-tracking permit fee levied at the Bwindi Impenetrable National Park from US\$5 to US\$10.

First, we formulated a detailed reconstruction of the causal mechanism for UPCLG's influence over UWA's policy change, identifying complementary and mutually exclusive explanations while interrogating any possible alternative explanations. During this iterative process, we tested different theories about what happened, gradually winnowing them out until we were left with the two contribution claims most strongly and convincingly supported by the evidence: that UPCLG lobbying appeared to have both accelerated and shaped UWA's policy decision. Table 2 breaks down our first contribution claim. The Bayesian updating figures indicate our confidence in each of the components of this claim, according to the evidence. We set the prior level of confidence at 0.5 for each step — equivalent to 'no information' (see Table 1 for confidence levels).

Applying this methodology increased our insight into how the policy change came about and allowed us to articulate the role of the UPCLG. Our process tracing analysis shed light on complementary and contributing factors — such as the presence of community pressure, which

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Knowledge Products

Toolkit

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we had not fully acknowledged in our initial causal mechanism. The analysis also reinforced lessons learnt from the project, such as the importance of including — and establishing trust between — different stakeholders from the outset of a project and the value of partnering with a national network of champions.

Table 2. Bayesian updating of contribution claim 1: UPCLG accelerated the process of change

Contribution claim and components	Bayesian updating	
	From (prior)	To (posterior)
Contribution claim 1: under long-term community pressure, the UWA board had tentatively started a discussion around changing the community share of the gorilla-tracking permit fee. UPCLG accelerated the process of change by providing new and relevant research findings, giving the UWA board an opportunity to think more about the policy change	0.5	0.63
Components of contribution claim 1:		
The communities around the Bwindi Impenetrable National Park have, for a long time, been dissatisfied with the amount of revenue they receive from permit fees. This dissatisfaction increased with a US\$100 rise in the permit fee from US\$500 to US\$600	0.5	0.91
The UWA board was already considering a change in the community's share of the fee	0.5	0.81
UPCLG, in collaboration with others, had undertaken research on the causes of illegal activity taking place in the park. This research:		
• Had generated new or original insight that justified or motivated the decision	0.5	0.69
• Was tailored to support advocacy work	0.5	0.77
• Was undertaken in a collaborative way, directly involving the UWA board in an attempt to build trust	0.5	0.63
UPCLG submitted a formal request to change the community's share of the fee to the UWA board, which acknowledged receipt and initiated a formal response process	0.5	1.0
A UPCLG member championed the change within UWA's formal response process through her role as a UWA committee chairperson	0.5	0.98

This document is part of the 'Better Evidence in Action' toolkit.

Further reading

Befani, B *et al.* (2016) Clearing the fog: new tools for improving the credibility of impact claims. IIED, London. <http://pubs.iied.org/17359IIED>

Befani, B and Stedman-Bryce, G (2016) Process tracing and Bayesian updating for impact evaluation. *Evaluation*. Vol 23, Issue 1, 42–60. <http://evi.sagepub.com/content/early/2016/06/24/1356389016654584.abstract>

For more information on the 'Research to policy — building capacity for conservation through poverty alleviation' project, see www.darwininitiative.org.uk/project/19013/