

# **Explaining claims with entity graphs**

Catalogue of argumentation patterns

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# Introduction

The first experiment showed that we can detect some repetitive patterns behind fact-checked claims that are somehow misleading. These patterns aim to capture the core of an argumentation developed by fact-checkers.

While other approaches (e.g., catalogues of persuasion or propaganda techniques, or argumentation ontologies) start either from the goal-oriented, pragmatic view or from the linguistic/lexicographic view, here we apply a knowledge engineering approach focusing on the graph structure by which the situation underlying the claim and fact-check can be described.

As a starting point, based on experiments on the data from [Demagog.cz](https://demagog.cz), we have identified some basic argumentation elements. Afterward, five annotators from FIS VŠE in December 2024 annotated 54 fact-checked reports from PolitiFact and tried to categorize claims based on these argumentation elements. Some new elements were discovered and added to this catalogue.

For modelling examples, a tool called PURO Modeler was used (Available at: <https://puromodeler.vse.cz/>).

In the future, we will continue improving this catalogue and creating models to study them.

May 2025: Launch of a new annotation campaign involving five annotators (KIZI FIS VŠE). The aim is to collect data for further research, which should help to improve the catalogue and to formalize the argumentation patterns. The data also serves for experiments with LLMs (bachelor's thesis by Richard Mládek).

## Published articles:

Haniková, K. (2025). Explaining Misleading Claims Using Graphs of Entities. In *The Semantic Web: ESWC 2024 Satellite Events* (pp. 94–103). Springer, Cham. [https://doi.org/10.1007/978-3-031-78955-7\\_10](https://doi.org/10.1007/978-3-031-78955-7_10)

Haniková, K., Chudán, D., Svátek, V., Vajdečka, P., Troncy, R., Vencovský, F., & Syrovátková, J. (2024). Towards fact-check summarization leveraging on argumentation elements tied to entity graphs. In *Companion Proceedings of the ACM Web Conference 2024* (pp. 1473-1481). <https://doi.org/10.1145/3589335.3651914>

# 1 Description of argumentation patterns

To explain an argumentation behind fact-checked claims, we have detected two types of elements:

1. A verdict argumentation element refers to the detection of what is wrong (or right) in the claim and in what way. These are seen as misinformation patterns, such as MISLEADING RELATIONSHIP.
2. An auxiliary argumentation element can also be expressed in the graph as part of the fact-checker argumentation, but does not establish a verdict. Usually, it refers to a part of the argumentation that is not mentioned directly in the claim but appears in the argumentation of the fact-checker, for example, presumed justification, denial justification, or recipient impression.

## 1.1 Misinformation patterns

Misinformation patterns focus mainly on what is wrong with the claim. A pattern is composed of two facets:

1. A noun that says what is wrong in the claim. These nouns can be:
  - RELATIONSHIP – a specific factual relationship between two objects
  - Linking multiple graph entities - as a distinct kind of relationship:
    - a. IDENTITY – two objects are claimed to be identical.
    - b. SIMILARITY – two objects (or even attributes/relationships/types) of the same kind are presented together, indicating that they are very similar in their characteristics (thus, “one kind”).
    - c. ASSOCIATION –if something relates to something else, evoking some misleading or false associations.
    - d. CONTRAST – two attribute values, or objects of the same kind, are presented as contrasting or very dissimilar. Usually, this is a consequence of using a false identity (comparing two situations that are not identical but have a significant contrast in some values).
  - ATTRIBUTE – an object is claimed to have some attribute or property. For example, if a car has some color, the color would be the property of the car. If we say that the car has a green color and it is actually red, it would be categorized as a FALSE ATTRIBUTE.
  - VALUE – a value of a *quantitative* attribute.
  - OBJECT – when an object in the claim is wrong. For example, if the claim says, “The man bought a house,” but he did not buy a house; he bought a car. “A house” would be a FALSE OBJECT.
  - TYPE – when an object is claimed to be from one class, but it should be from a different class. For example, if the claim says, “The man bought the ABC012,

which is an expensive watch”, however, the “ABC012” is not a watch but a car. So, an expensive watch would be a FALSE TYPE.

- SUBSET – a smaller group that is a part of a larger group. For example, members of Congress have two subsets: Republicans and Democrats. The subset is usually represented as a “Type” node in the graph; however, we do not use the noun TYPE as such since the issue with the type also has to do with its super-type and not with the given type alone. Usually, there is a MISSING SUBSET in the claim. For example, “Group A has done action A.”. However, there also exists a group B that contributed to action A.
  - EVENT – claimed to have happened in the past or predicted to happen in the future. An event is a special kind of object and would typically be expressed by an Object node in the entity graph. However, talking about ‘something happening’ has a special flavor when fact-checking, so we reserve a dedicated noun instead of just OBJECT.
  - UTTERANCE – an agent is claimed to have uttered a statement. For example, person X said that person Y said some utterance. However, person Y did not say that.
2. An adjective that helps to specify in what sense the referent of the noun is “wrong”:
- MISLEADING – a claim or its part can be technically true, but misleads to some other direction
  - FALSE – the problematic part is not true, can be disproved
  - UNSUBSTANTIATED – not enough evidence available
  - MISSING – something important in the claim is missing
  - EXAGGERATED – objects, relationships, or values are made to seem more significant, smaller, or worse/better than they actually are

The adjective TRUE can also be used if relevant, although normally, a part of a diagram not labeled by one of the above adjectives is implicitly assumed to be true. These elements are used more for explanatory parts of a diagram.

## 2 Examples

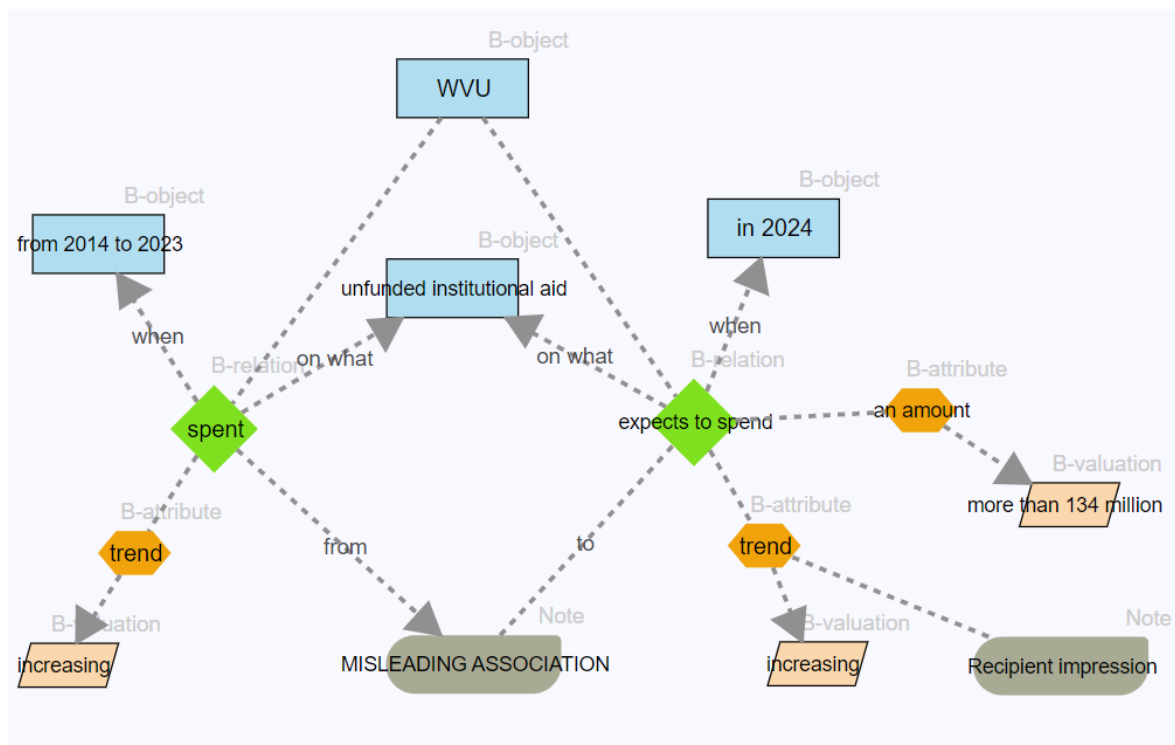
### 2.1 MISLEADING ASSOCIATION – WVU institutional aid

<https://www.politifact.com/factchecks/2023/oct/10/paula-congelio/has-west-virginia-university-increased-unfunded-ai/>

Claim: West Virginia University **has “increased the amount** of unfunded institutional aid provided to students and expects this amount **to exceed** \$134 million in 2024.”

Fact-check (short): Scholarship and tuition waivers at West Virginia University come in two major categories: aid supported by outside sources, such as governments or foundations, and aid from the university itself. Every year from 2014 to 2023, WVU increased internally funded aid to undergraduate and graduate students. Internally funded aid is poised to drop slightly in 2024, to about \$134 million.

1. We try to read the summary (the box “if your time is short”) to get an idea of what is wrong with the claim. It says that internally funded aid is poised to drop slightly in 2024 to about \$134 million. However, in the years before, there was growth. The claim causes the feeling that in 2024, it will rise as well. The core problem is highlighted in the claim above.
2. So, we have detected two relationships (*has increased* and *expects to exceed*). These two relationships evoke some association – that in 2024, the unfunded aid will increase as it has in the years before. Now, we can say that this association is MISLEADING ASSOCIATION. This is misleading because it is not false (the amount is correct, and the increasing trend before 2024 is also true).



## 2.2 MISLEADING RELATIONSHIP – US emissions

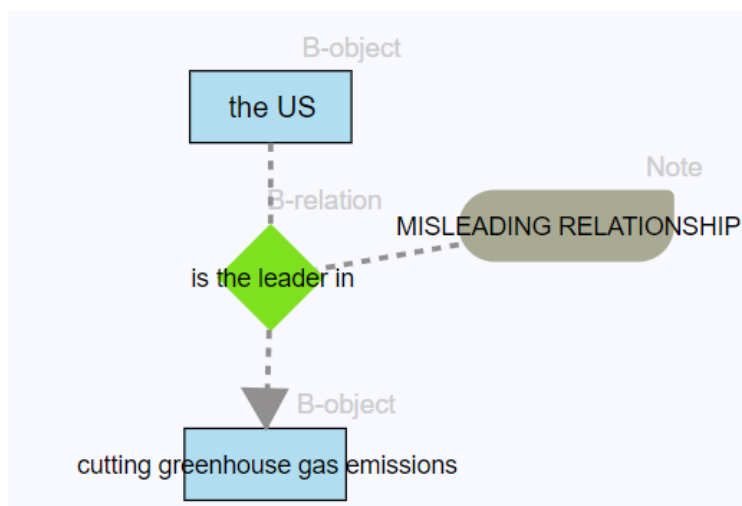
<https://www.politifact.com/factchecks/2022/apr/06/dan-sullivan/does-us-lead-cutting-greenhouse-gases-it-depends-h/>

Claim: In cutting greenhouse gas emissions, the United States **is “the leader”** in the world by far.”

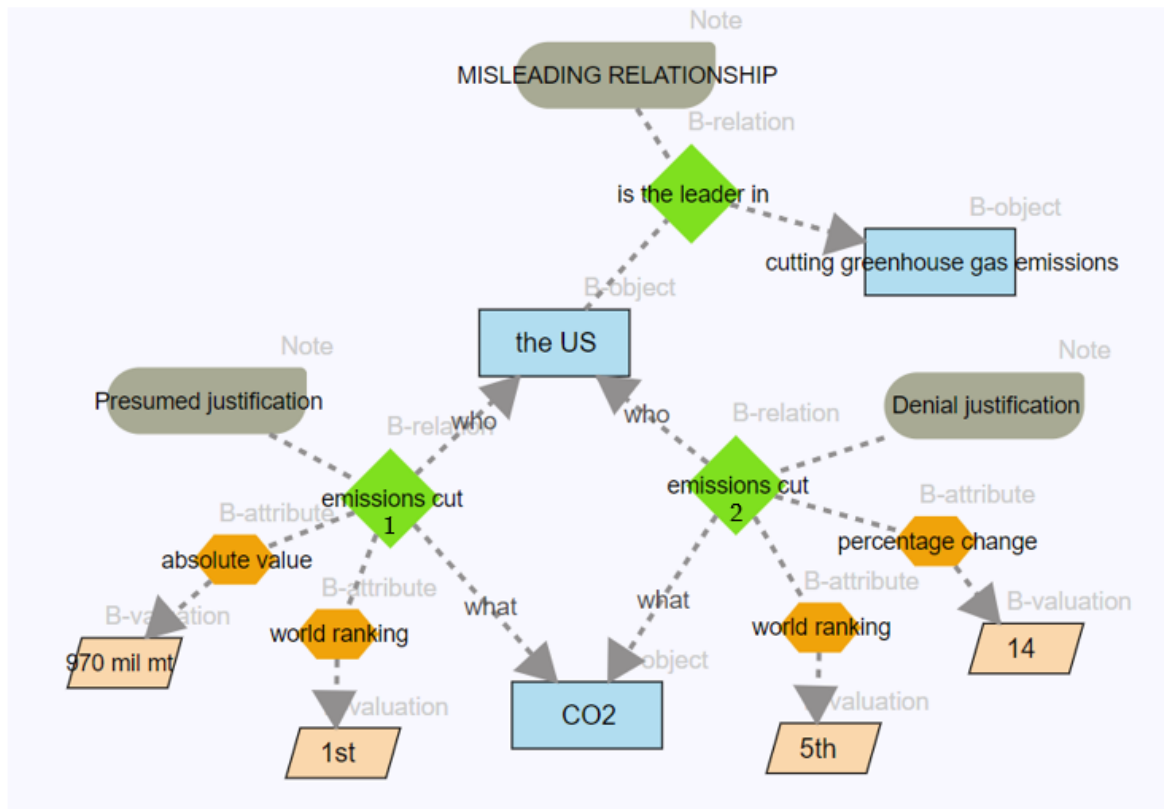
Fact-check (short): Carbon dioxide emissions in the U.S. fell by about 880 million metric tons in 2019 compared with 2005. That was more than any other country, but as a percentage change, the U.S. ranks fifth worldwide. On a per-person level, U.S. emissions remain twice that of China.

Explanation of chosen pattern: In total metric tons, the claim is true. However, as a percentage change, the U.S. would be fifth worldwide. The claim misleads an audience into thinking that the US is the best at cutting greenhouse gas emissions. However, with added context, we can see that the situation is not as positive as it was presented (as the leader position only holds when we consider one (more biased) metric). We have detected that the relationship “is the leader in” is MISLEADING RELATIONSHIP.

Model of a claim:



Model with explanation:





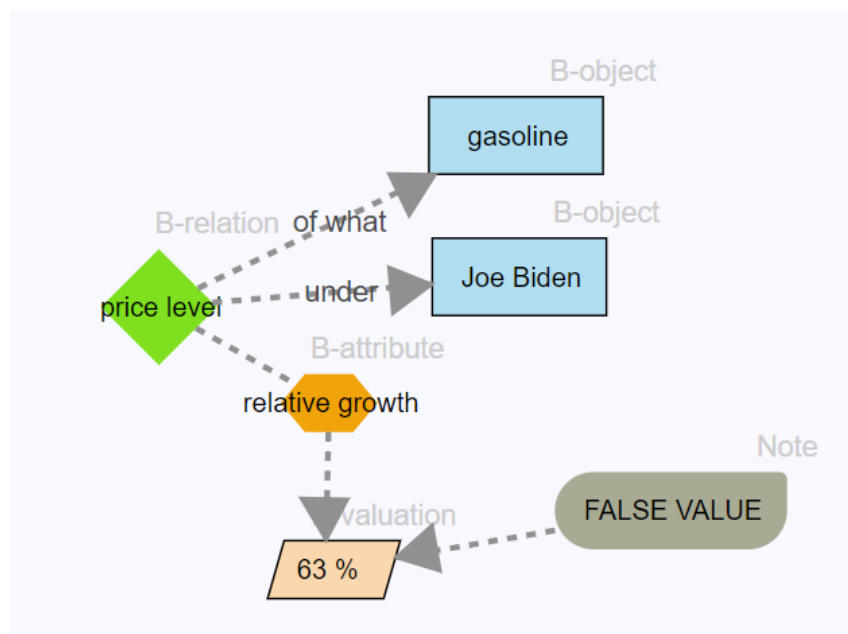
## 2.3 FALSE VALUE – gasoline prices

<https://www.politifact.com/factchecks/2023/nov/02/chris-rose/have-gasoline-prices-risen-by-63-during-joe-bidens/>

Claim: Gasoline prices are "**up 63%**" under President Joe Biden.

Fact-check (short): Gasoline prices have risen under Biden, but the claim used out-of-date data. By the time of the post, gasoline prices had retreated, making the increase under Biden 48% rather than 63%. Experts say that the rise under Biden was largely independent of his policies. Gasoline prices rose initially because of an economic comeback after the pandemic slowed, and then spiked further after Russia invaded Ukraine.

Explanation of chosen pattern: Wrong value (FALSE VALUE). Prices were up 48 % by the time of the post, not 63 %.



## 2.4 FALSE RELATIONSHIP – covid kids

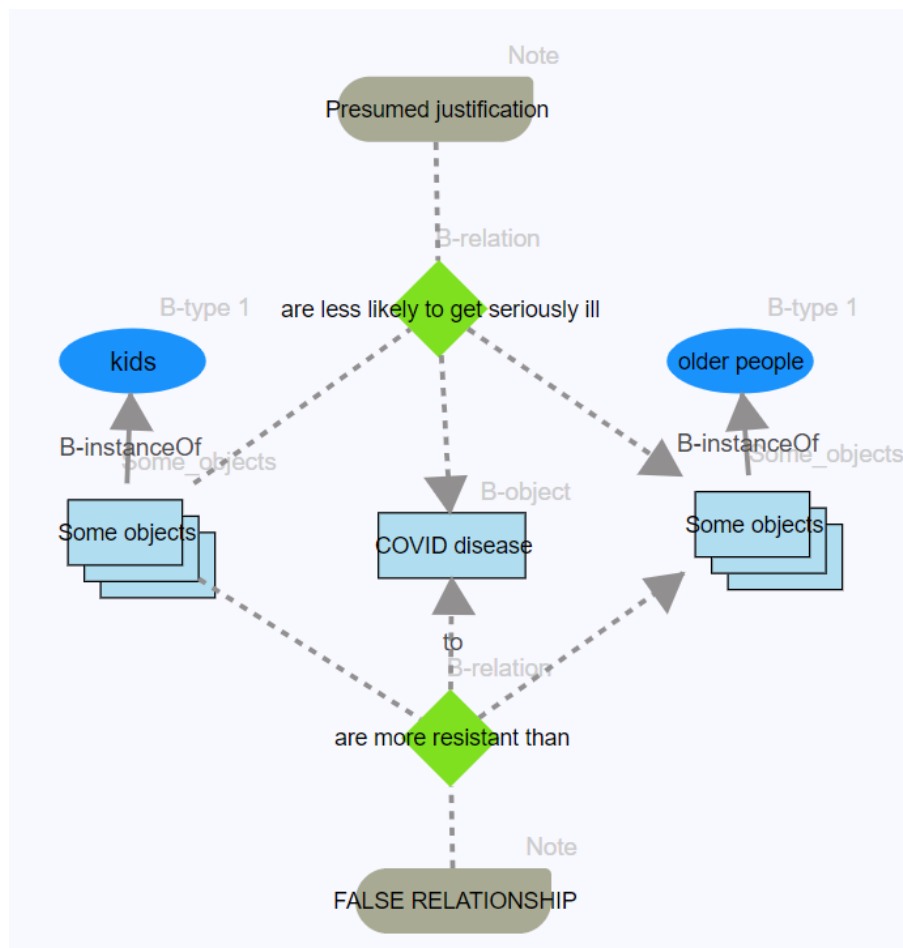
<https://www.politifact.com/factchecks/2022/oct/28/tom-horne/republican-arizona-school-chief-candidate-said-kid/>

Claim: “Kids **are resistant** to COVID as opposed to older people.”

Fact-check (short): In Arizona and nationally, children are much less likely than older people to become seriously ill or die from COVID-19, the disease caused by the novel coronavirus. The trend for infections is more complicated; at times, the infection rate for children has been lower than for older people. Later in the pandemic, it was higher. Whether they show symptoms or not, infected children can pass the virus on to others.

Explanation: Kids are not more resistant to COVID-19; later in the pandemic, children's infection rate was higher. Kids are less likely to get killed by this virus. So, we have detected a relationship that is wrong – FALSE RELATIONSHIP.

In the diagram, we use the “Some objects” construct. This construct is used because the claim doesn’t discuss concrete kids or older people. So, if we have “Some objects” as instances of “kids,” it is some group of objects that have in common that they are kids.



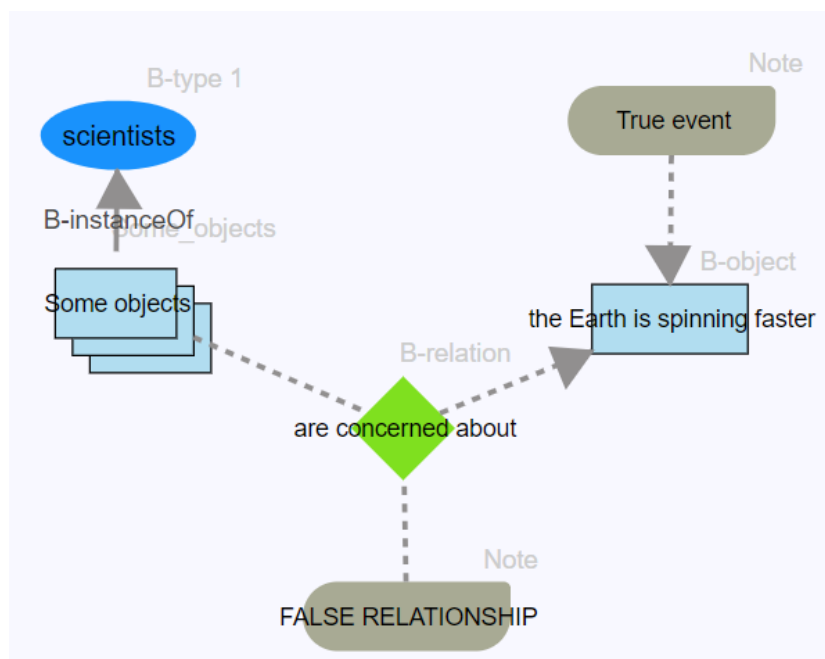
## 2.5 FALSE RELATIONSHIP – Earth spinning

<https://www.politifact.com/factchecks/2022/aug/31/facebook-posts/earth-spun-little-faster-recently-scientists-arent/>

Claim: “The Earth just started spinning faster than ever before and **scientists are gravely concerned.**”

Fact-check (short): On June 29, 2022, Earth completed a rotation about 1.59 milliseconds faster than the 24-hour standard. That’s the shortest day on record since we started atomic timekeeping in the 1960s. That doesn’t mean anything dangerous for Earth’s inhabitants. With enough speeding up of the Earth’s rotation, atomic timekeepers could one day add a “negative leap second,” or remove one official second from one day.

Explanation: Scientists **are not concerned**. So, there is FALSE RELATIONSHIP.



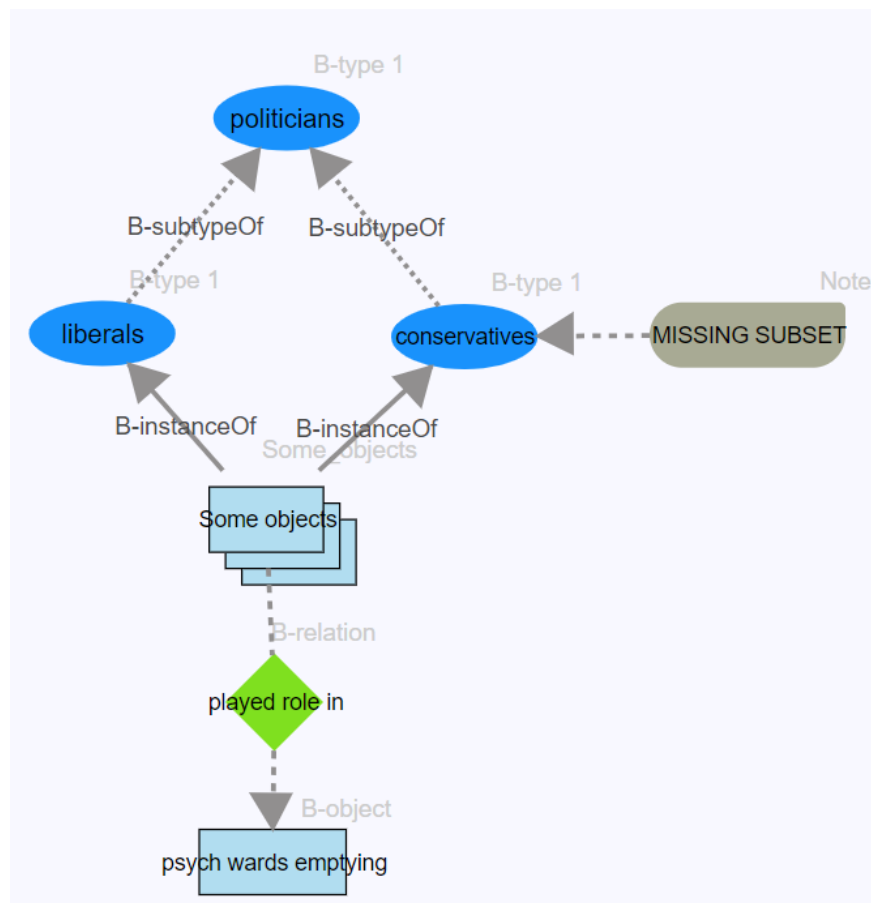
## 2.6 MISSING SUBSET – psych wards

<https://www.politifact.com/factchecks/2023/apr/20/mike-pence/mike-pence-said-liberals-emptied-mental-hospitals/>

Claim: "In the 1960s, **liberals** emptied our psych wards."

Fact-check (short): Some of the impetus for moving people with serious mental illness out of institutions in the 1960s came from legislation signed by Democratic presidents and supported by civil rights advocates. **But fiscal conservatives**, many of them Republicans, **also played a crucial role** — notably Ronald Reagan, who signed landmark legislation, first as California's governor and then as president.

Explanation: We have a set of people who somehow played a role in emptying mental hospitals. The claim says that those are liberals. However, others should be in this set of people – fiscal conservatives and Republicans. So, the claim is leaving out an important subset of people who also played a role in emptying mental hospitals. There is a MISSING SUBSET.



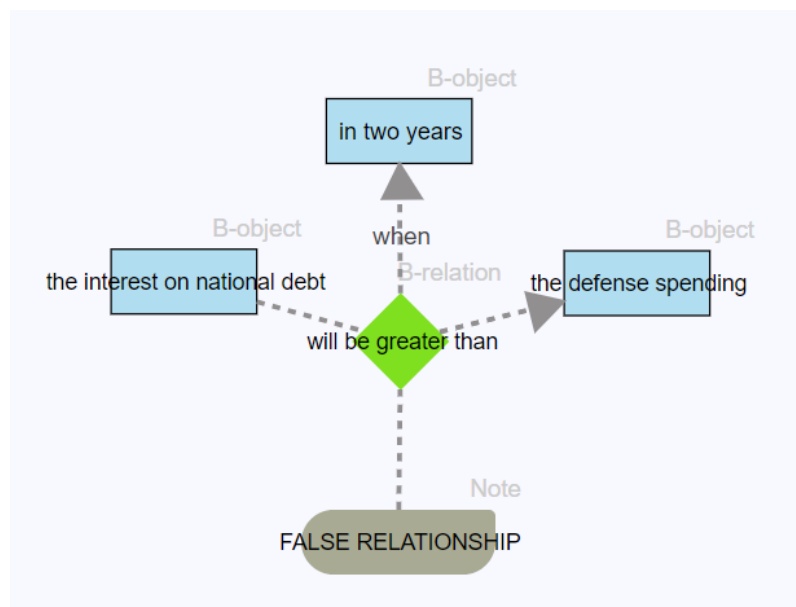
## 2.7 FALSE RELATIONSHIP – national debt

<https://www.politifact.com/factchecks/2023/apr/05/mike-pence/interest-federal-debt-costing-more-national-defens/>

Claim: “In the next two years, **we’ll spend more** on interest on our national debt than we do on the national defense.”

Fact-check (short): A common, apples-to-apples method — the most recent Congressional Budget Office projections, from February 2023 — shows that net interest on the national debt is projected to exceed defense spending starting in fiscal year 2029, but not in the next two years. It’s possible to envision scenarios that would speed up that date, but doing so would be speculative.

Explanation: In two years, the interest on the national debt **will not be greater** than the defense spending. It will be later. There is FALSE RELATIONSHIP.



## 2.8 FALSE VALUE – border encounters

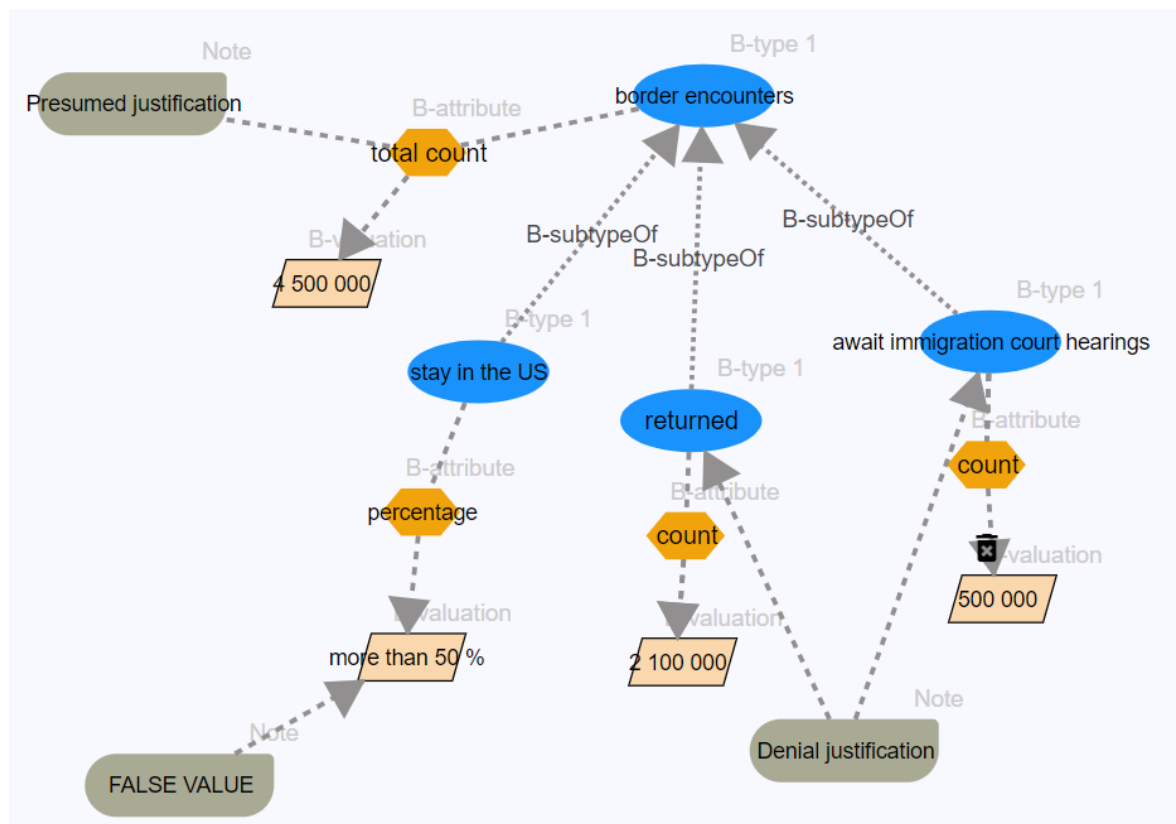
<https://www.politifact.com/factchecks/2023/feb/03/chip-roy/chip-roy-cites-correct-border-encounters-data-wron/>

Claim: "Under Biden, we have seen over 4.6 million encounters at our southern border. **Most** have been released into the interior and will stay here indefinitely."

Fact-check (short): About half of the 4.5 million encounters at the border ended in an immigrant leaving the U.S. At least 2.1 million of them ended in an immigrant being immediately sent back to Mexico or their home country under a public health rule. Another 500,000 immigrants have been detained in the U.S. as they await immigration court hearings. Not all of the immigrants released into the U.S. will stay in the country indefinitely. Some lose their asylum cases and are sent back to their home country.

Explanation: First, there were 4.5 million border encounters under Biden, but 4.6 million count includes encounters in January 2021, when Biden was not president for most of that month

Secondly, it is not true that most of them stayed in the country; more than half of them were sent away. This indicates that the border encounters are divided into more subsets, and the subset of people that stay in the US is smaller than suggested in the claim. Hence, FALSE VALUE, or we could use a more suitable term, FALSE SUBSET SIZE. However, we want to have the catalog as simple as possible, and the distinction between FALSE VALUE and FALSE SUBSET SIZE could be difficult in some cases so that we will prefer FALSE VALUE.



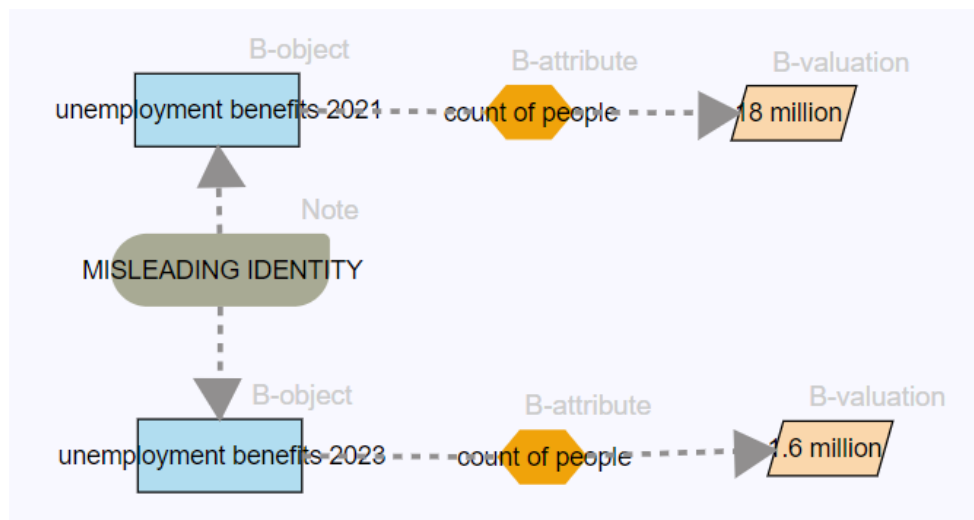
## 2.9 MISLEADING IDENTITY – unemployment benefits

<https://www.politifact.com/factchecks/2023/jan/27/joe-biden/joe-biden-touts-big-joblessness-drop-but/>

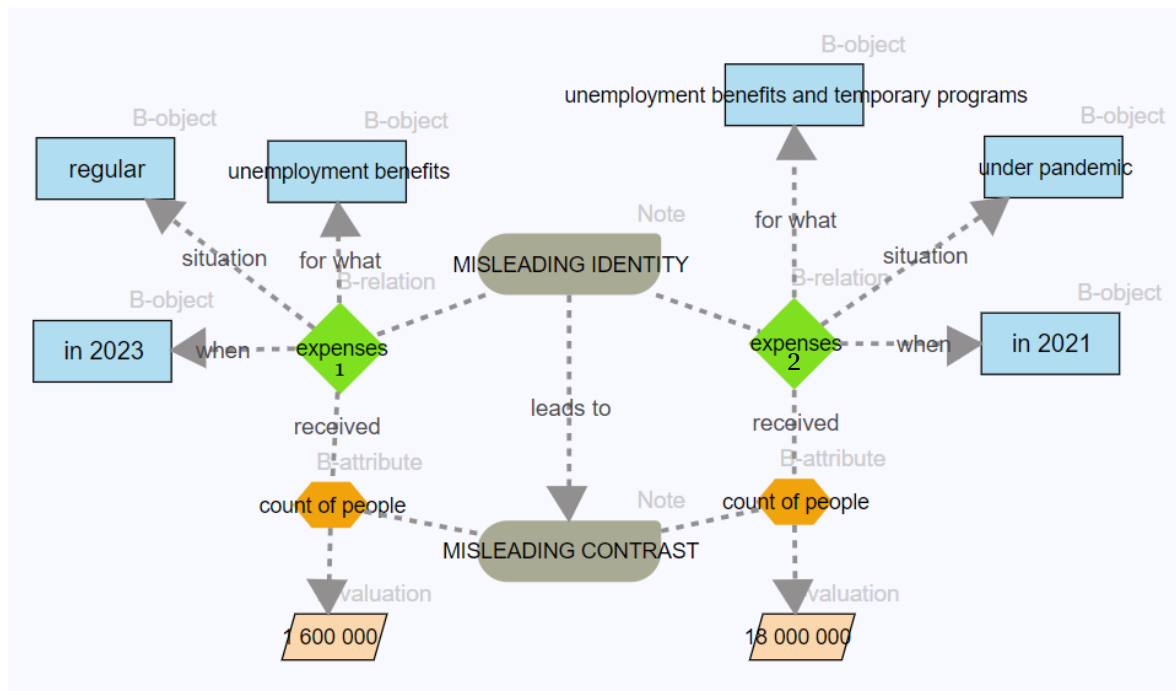
Claim: “Two years ago this week, 18 million people were out of work needing unemployment benefits. Today, that number is under 1.6 million, the lowest in decades.”

Fact-check (short): Biden’s 18 million figure accurately represents the combination of traditional unemployment insurance recipients and those who benefited from temporary programs during the coronavirus pandemic. The number of unemployment claims today is about 1.6 million, as Biden said. However, Biden’s two snapshots in time aren’t precisely comparable because the pandemic programs have been phased out. And some people who received benefits in 2021 also didn’t fit the official “unemployed” definition.

Explanation: The numbers are accurate; however, these two rates are not precisely comparable. It evokes the idea that these two snapshots in time are identical, but they are not; they represent two different situations. So, there is a comparison of two objects presumed to be identical. But they are not identical, and there is MISLEADING IDENTITY.



Extended version:





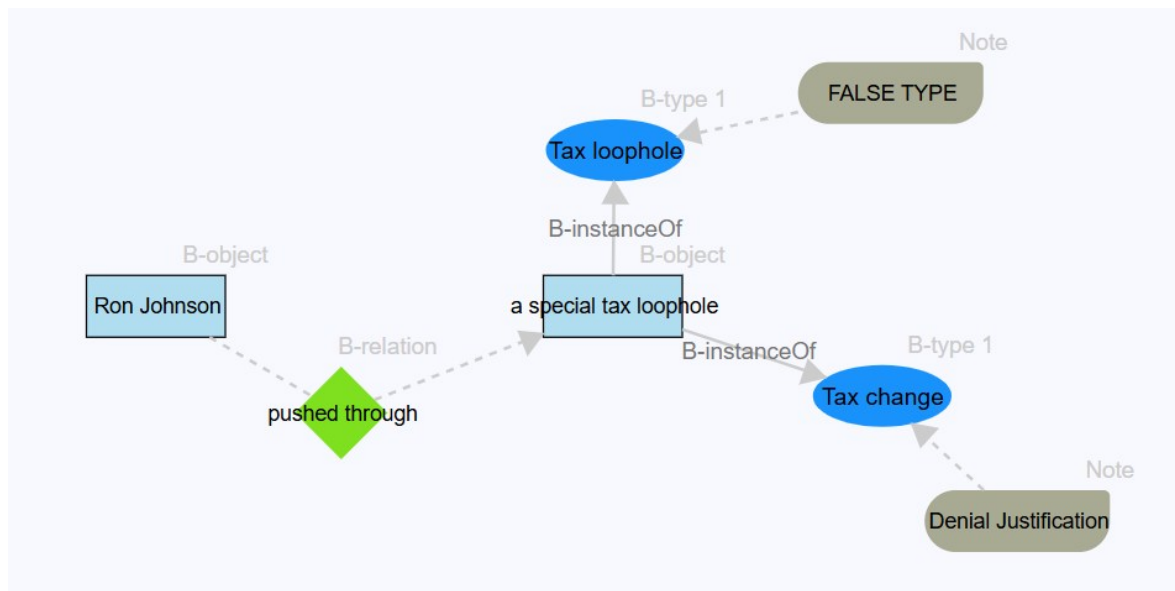
## 2.10 Multiple patterns - FALSE TYPE, EXAGGERATED REALTIONSHIP, MISSING SUBSET

<https://www.politifact.com/factchecks/2022/apr/27/opportunity-wisconsin/johnson-benefitted-tax-cut-its-not-loophole/>

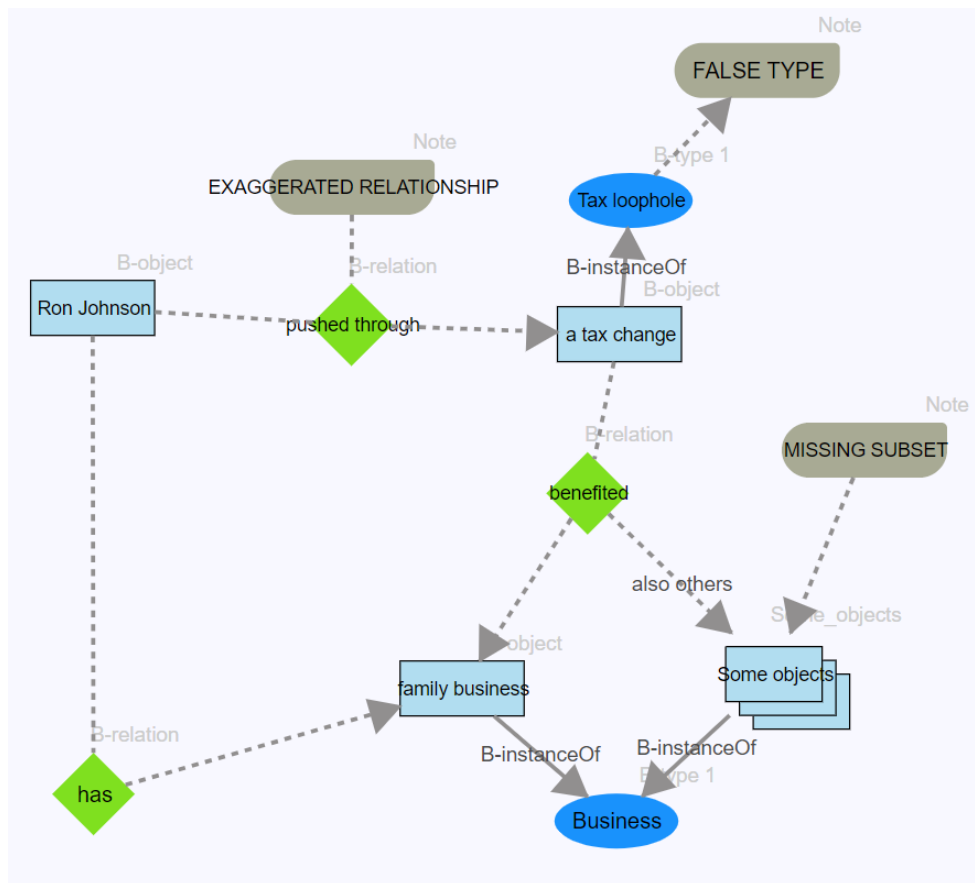
Claim: "Ron Johnson pushed through a special tax loophole that benefited his own family's business ... Then he cashed out of the company for \$5 million ... (he has) doubled his wealth since taking office."

Fact-check (short): In 2017, Johnson provided a key vote for former President Donald Trump's massive tax bill on the condition it included a provision for "pass-through" entities, typically small businesses. But that wasn't a loophole – it was done in the open and benefitted almost 25 million businesses across the country. In 2020, Johnson sold his interest in the family-owned business for between \$5 million and \$25 million. Johnson's estimated wealth increased 102.2% since taking office in 2011.

Simplified diagram aiming at the core problem – a tax loophole:



More detailed diagram, revealing more issues:



Explanation of pattern: The core problem is the first part of the claim; the other two are true. The first part says, “Ron Johnson pushed through a special tax loophole that benefited his family’s business.” The tax change that he contributed by his vote, wasn’t a loophole, so it was falsely classified as the loophole (FALSE TYPE). Also, the tax change was not only Johnson’s idea; other people supported this change, so the relationship “pushed through” is EXAGGERATED RELATIONSHIP. Overall, it leads to the impression that he did it only so his business could benefit. However, other businesses also benefited - there is a MISSING SUBSET of other companies that benefited from this tax change.

## 3 New climate models March 2025

### 3.1 Water in California – FALSE VALUE

<https://www.politifact.com/factchecks/2025/jan/14/more-perfect-union/does-a-billionaire-couple-own-almost-all-the-water/>

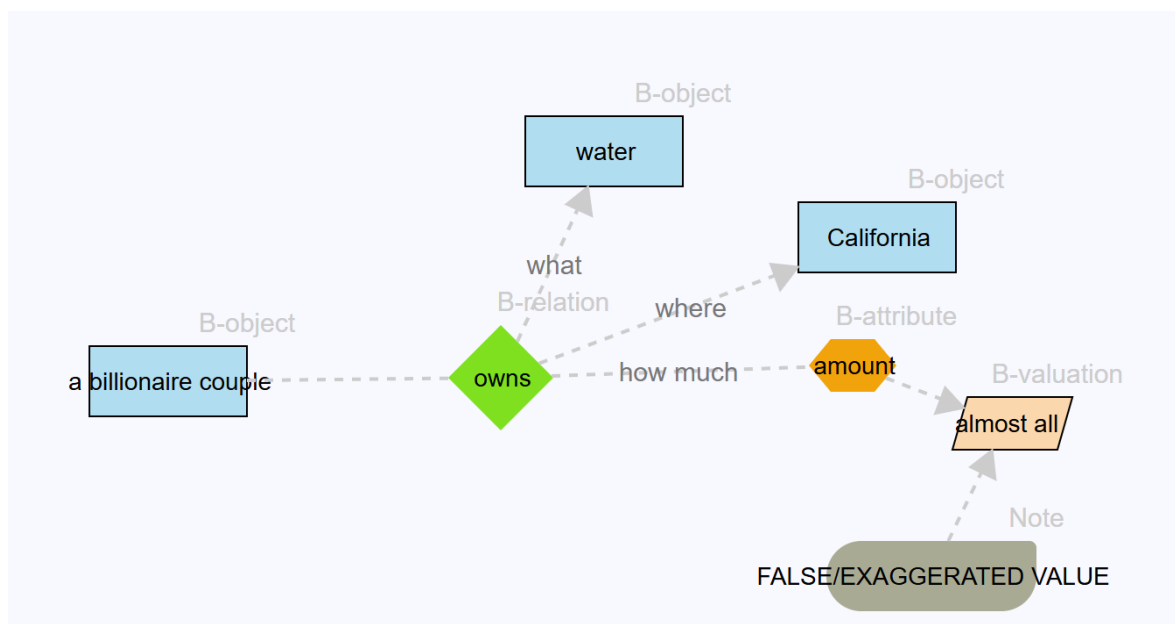
Claim: “One billionaire couple owns almost all the water in California”

Fact-check (short):

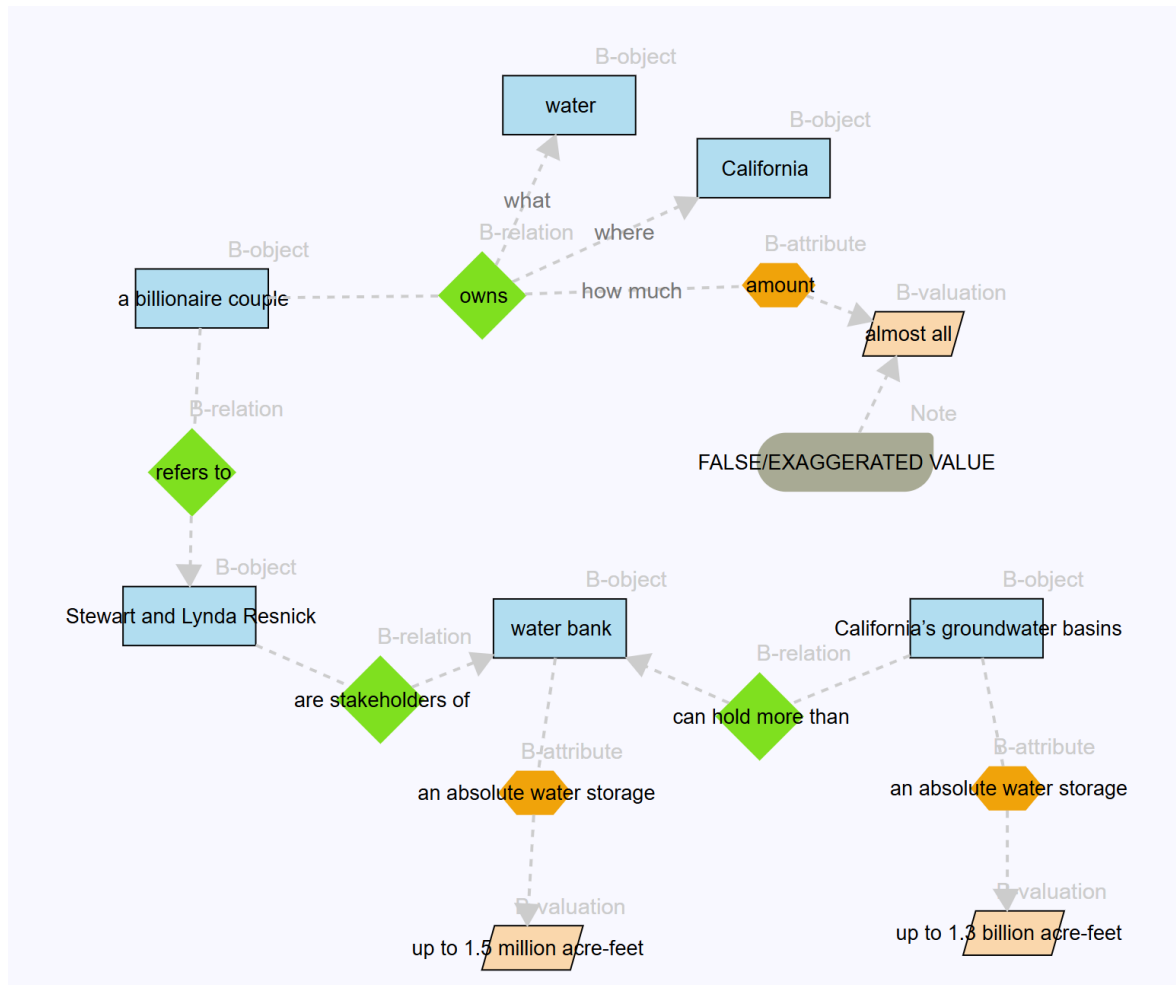
- The owners of the privately held agricultural business, Wonderful Co., do not own most of California’s water.
- Through the Wonderful Co., Stewart and Lynda Resnick have a majority stake in a water bank that can store up to 1.5 million acre-feet — close to 500 billion gallons — of water. That’s a tiny fraction of the state’s overall water supply.
- California’s groundwater basins combined can hold more than 566 times as much water with a storage capacity of 850 million to 1.3 billion acre-feet, according to the California Department of Water Resources. The state’s surface reservoirs can hold more than 40 million acre-feet on top of that.

Explanation of pattern: A billionaire couple (Stewart and Lynda Resnick) owns only a small fraction of California’s water. The “almost all” VALUE in the claim is FALSE. A water bank, where they have a majority stake, can store up to 1.5 million acre-feet of water. While California’s groundwater basins combined can hold between 850 million and 1.3 billion acre-feet, according to the California Department of Water Resources. The state’s surface reservoirs can hold more than 40 million acre-feet on top of that.

Misinformation pattern:



Detailed explanation:



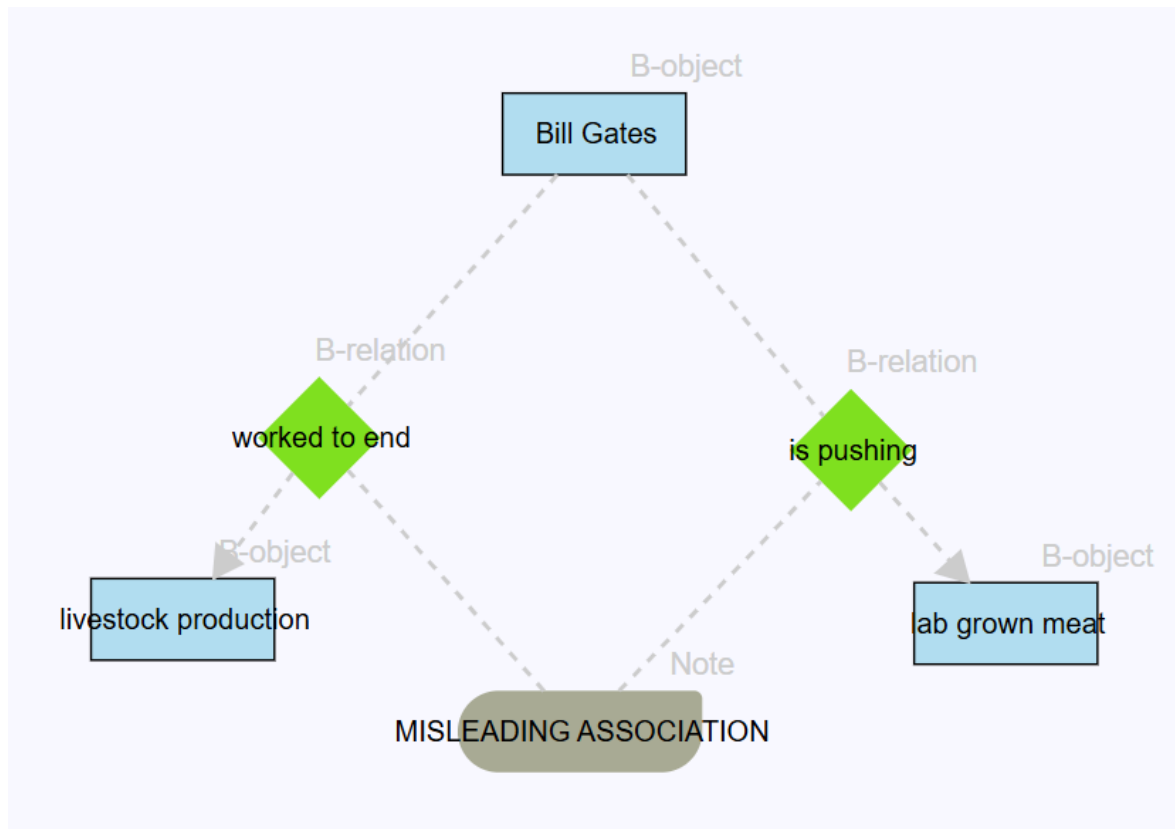
### 3.2 Bill Gates and lab grown meat – MISLEADING ASSOCIATION

<https://www.politifact.com/factchecks/2020/may/18/facebook-posts/what-bill-gates-has-do-livestock-lab-grown-meat/>

Claim: "Bill Gates worked to end livestock production, and is pushing lab grown meat."

Fact-check (short):

- Gates has invested at different times in several companies making meat replacement products, including Memphis Meats, which grows meat from living cells in a lab.
- We found no evidence that Gates has worked specifically to end livestock production.
- Gates has said livestock are critical to fighting poverty. The Bill & Melinda Gates Foundation has committed grants toward helping farmers get more out of their livestock.



Explanation of the pattern: This claim has two parts: the first is that Bill Gates is pushing lab-grown meat, and the second is that Bill Gates worked to end livestock production. Although Bill Gates indeed invests in lab-grown meat, the claim leads to a misleading association that he also worked to end livestock production. There is no evidence to support it; on the contrary, Bill Gates supports livestock production in developing countries.