

## Section 2: Critique of Retroductive Arguments

Retroductive arguments are those in which an explanation is suggested to account for an observed fact or set of facts. The explanation is suggested by what I call a “concomitance,” i.e. any type of similarity or co-occurrence, including location in time or space, but not restricted to these. For example, “Jones was in the building during each of the murders. Perhaps he is the killer,” or “The blood on the victim’s shirt matches Jones’ blood type. Perhaps Jones is the killer.” Because retroductive arguments turn only upon observed concomitances, and concomitances can always be merely coincidental, retroductive arguments run a high risk of being mistaken. Hence, in terms of establishing the truth of the conclusion, retroduction is the weakest type of argumentation. However retroduction is the only type of argumentation that suggests new connections in the structure of the world, so without this type of argumentation the growth of knowledge would be impossible.

Because retroduction is the weakest form of reasoning, i.e. the form of reasoning most prone to error, no retroductive argument can be trusted. On the other hand, any explanation is bound to be better than no explanation at all, so no retroductive argument is entirely to be despised. The result is that, when critiquing retroductive reasoning, we can only make comparative judgments. Consider two explanations together, and try to determine which of the two is better and which is worse. In the case of inductive arguments, the criteria for critique translated rather directly into a list of fallacies. In the case of retroduction, this appears to be less true. I believe this is because retroductive arguments cannot be critiqued individually, but must be *compared* to other retroductive arguments that have only the minor premiss in common.

There are five specific criteria by which the better explanation will distinguish itself from the weaker one:

- I. Simplicity – the better theory appeals to the smallest possible number of causal factors.
- II. Plausibility – the better theory appeals to principles that are widely accepted, recognized, and understood.
- III. Naturalness – the better theory appeals to causal factors that operate without conscious manipulation, direction, or control.
- IV. Fecundity – the better theory has greater explanatory power.
  - A. Number of facts – the better theory explains more facts, including (especially) facts not originally seen as part of the problem.
  - B. Diversity of facts – the better theory explains a greater diversity of facts, including facts in other fields of study.
  - C. Generality of facts – the better theory explains whole categories of events, rather than only individual events.
- V. Testability – the better theory makes numerous “predictions” that can be tested. This is sometimes called “risk of disconfirmation,” since the theory risks being refuted if the predictions do not turn out as expected.

## I. Simplicity

This principle is called Ockham's Razor. Ockham himself expressed the principle by saying, "Don't multiply entities unnecessarily." By "entities" it is assumed that Ockham meant "causes," i.e. any factors, forces, mechanisms, laws, etc., that might have an influence on the facts to be explained. The stronger explanation appeals to the smaller number of such factors—ideally only one—rather than relying on multiple unrelated causes. Since the co-occurrence of two (or more) unrelated causal factors is a coincidence, this criterion could also be expressed by saying that the stronger explanation avoids appealing to coincidences or unusual circumstances.

### *Example:*

A patient is suffering from sore throat, rash, low blood pressure, abdominal pains, and a cough. No known disease accounts for all of these symptoms in combination.

Theory 1: The patient has a cold, fell into some poison ivy, and ate some bad chicken salad, all at about the same time.

Theory 2: The patient has a cold, but also suffers from a rare neurological condition that is causing the rash, low blood pressure and abdominal pains.

Theory 3: The patient has a cold. To relieve the cough, the patient was given pills that look similar to cough medicine, but are actually intended to treat gout. The gout medication is causing the other symptoms

*Theory 2 is better than theory 1, but theory 3 is the best. It still involves two causal mechanisms rather than three, but the two are causally connected since the pills were intended to relieve the cough due to the cold. (From Episode 3 of the TV drama House.)*

However, coincidences do occur. A theory cannot be ruled out on the grounds that it has some coincidences in it. Even so, where the explanation does appeal to coincidences or unusual circumstances, it should do so only to the extent that such coincidences and circumstances are known to occur, i.e. the coincidences are reasonably probably under the circumstances.

### *Counterexample:*

More ships disappear in the Bermuda Triangle than anywhere else in the ocean.

Theory 1: They are being abducted by alien space ships.

Theory 2: Each disappearance each has its own separate explanation.

*By Ockham's Razor, Theory 1 is better than theory 2, but in fact the number of shipping lanes that pass through the Bermuda Triangle is so great that the number of coincidental disappearances in that area is about what would be expected, given the exceptionally large number of ships in the area.*

## II. Plausibility

It is better to appeal to familiar forces and mechanisms rather than to unfamiliar forces and mechanisms. That is, the better explanation appeals to, or is consistent with, laws, forces and mechanisms already familiar to us from other contexts—acknowledged laws of physics and recognized patterns of human behavior—rather than proposing new laws, forces and mechanisms or appealing to mechanisms not generally believed to exist.

*Example:*

Several patients, all of whom were staying at the same hotel in Los Angeles, have come down with a cluster of symptoms: swollen glands, difficulty breathing, high fever, nausea and dizziness. Several of the patients have died of the illness. The cause of the disease is a mystery.

Theory 1: We are dealing with an “emergent” disease germ, i.e. one that has only recently adapted itself to attack humans.

Theory 2: Hanta virus, carried in mouse feces, can cause these symptoms. It occurs on Navaho reservations, but it is very rare since the Navaho people have an old cultural taboo against living in a house in which mice have been seen. The virus has re-emerged and was transported to that hotel by a truck that stopped in Tuba City on its way to L.A.

Theory 3: The patients are not suffering from a disease at all, but are the victims of a voodoo curse.

*Theory 1 is better than theory 3 since it appeals to a type of mechanism that is recognized by medical authorities. However, theory 2 is the best, since it appeals to a mechanism already known to exist rather than postulating the existence of a previously unknown mechanism.*

However, science could never progress if we ruled out all theories on the grounds that they have introduced a previously unrecognized cause. Where new laws, forces and mechanisms are proposed, the resulting explanation should be compellingly elegant in other respects.

*Counterexample:*

Heavy objects fall.

Theory 1: Their natural place is to be at or near the center of the universe.

Theory 2: They are attracted toward each other by a previously unrecognized invisible force that operates across vast distances for no apparent reason.

*Theory 1 is Aristotle’s theory of gravity; Theory 2 is Newton’s. What Newton’s theory lacked in plausibility, it more than made up in simplicity and fecundity.*

### III. Naturalness

It is better to appeal to forces and mechanisms that operate without conscious direction rather than to mechanisms that require agency and contrivance (artifice). The better explanation appeals to mechanisms that operate without conscious direction, rather than appealing to the action of a conscious, willful agent. Cooperation by two or more agents compounds the amount of planning needed, since their actions must be coordinated. Even where actions are conscious and deliberate, there is a difference in naturalness between actions that are habitual, routine, and require little thought, vs. those that require skill, planning and care.

As the mayor of Roswell, New Mexico once said, "Never attribute to deviousness what can be explained by incompetence."

#### *Example:*

A patient recently died while suffering from severe stomach cramps and vomiting. It is known that he enjoyed cooking and eating wild mushrooms, and that he recently collected and ate some edible mushrooms that are similar in appearance to a poisonous species of wild mushrooms. The active poison in these wild mushrooms can be made artificially in a laboratory, if you know how.

Theory 1: The patient accidentally collected and ate some of the poisonous variety of wild mushrooms, mistaking them for the edible variety he had also collected.

Theory 2: The patient was murdered. Someone artificially produced the poison in a laboratory and put the poison in the patient's stew of edible mushrooms.

*Theory 1 is the better theory, since the poisoning does not involve deliberate action, only carelessness. Theory 2 requires at least two deliberate and complex actions: (a) making the poison and (b) putting it in the victim's food.*

However, planning does occur. We cannot rule theories out merely because they involve some degree of contrivance. So, where an explanation does appeal to the planned action of conscious agents there should be some evidence of such planning and action.

#### *Counterexample:*

*The above example is its own counterexample. Theory 2 is initially the weaker theory, but it becomes the stronger theory when lab tests prove that the poison in the stew was synthetic, not natural. The story is taken from a murder mystery by Dorothy Sayers (co-authored with Robert Eustace), *The Documents in the Case*.*

#### IV. Fecundity

A strong explanation is consistent with all of the facts, and may even explain some facts that were not originally seen as needing explanation; a weak explanation may omit, or even be inconsistent with some of the relevant facts. Moreover, the stronger explanation will explain a diversity of facts, i.e. facts relevant to different areas of study, or facts widely separated in time and space, etc. Finally, the stronger explanation explains a whole category of facts rather than explaining only individual events. It fits the facts into a larger pattern. The weaker explanation treats the event to be explained as an isolated incident, i.e. as an anomaly or an exception.

*Example:*

In the early days of radar, radar operators would occasionally observe crackling patches on the radar screen, too large and fuzzy to be an airplane. The patches sometimes moved against the direction of the wind. Radar operators called these phenomena “angels.”

Theory 1: The crackling patches are caused by storms or large clouds.

Theory 2: Radar was able to prove the actual existence of angels.

Theory 3: The crackling patches were caused by flocks of migratory birds.

*Theory 1 is not consistent with the facts, since storms and clouds do not move against the wind that drives them. Aside from lacking plausibility, Theory 2 treats each fuzzy patch as a unique event, since there is no known regularity to the movements of angels. Theory 3 is clearly the best. It explains the size and fuzziness of the crackling patches, as well as their ability to move against the wind. In addition it was not noticed until after this explanation was proposed that the “angels” were most active in the early morning and early evening, and in late March and in late October, moving mainly to the north in March and to the south in October.*

However, being inconsistent with some of the “facts” does not utterly disqualify a theory. This may merely indicate that our understanding of the facts is mistaken. Theories that are not consistent with all the facts can sometimes provide an incentive to re-check—and occasionally correct—our understanding of the facts. In addition, theories that are not consistent with all the relevant facts sometimes drive further research aimed at bringing the recalcitrant facts in line with the theory. Often such research leads to further discoveries.

*Counterexample:*

*Newton’s theory of gravity was successful because it seemed to explain the motion of planets, as well as the behavior of falling things on Earth. However, this was not strictly true. Newton’s theory was inconsistent with the orbit of Uranus. This inconsistency was resolved when the planet Neptune was discovered by astronomers working on the theory that Uranus was being pulled out of its predicted orbit by a more distant planet. Prior to that time, while Neptune had been seen, it was believed to be a star.*

## V. Testability

A strong explanation suggests further observations (called “predictions”) which are unlikely to be realized or manifested if the explanation is not true, but are highly likely to be manifested if the explanation is true; a weak explanation offers few predictions, or only predictions that cannot be put to the test in practice.

*Example:*

In 1980 Walter and Luis Alvarez discovered a thin layer of rock containing surprisingly high concentrations of a rare substance known as iridium. This layer appears in rocks all around the world. The layer of rock happens to be at the K-T boundary, i.e. the layer of rock laid down 65 million years ago marking the boundary between the Cretaceous and the Tertiary, just when the dinosaurs became extinct.

Theory 1: 65 million years ago the earth was visited by alien big game hunters. They hunted the dinosaurs to extinction, and took some of them back to their planet to be put in alien zoos. The layer of iridium is residue from the blast of their interstellar hyper-drive space ships.

Theory 2: 65 million years ago the earth was struck by a large comet or asteroid. The destruction caused by the impact killed the dinosaurs. The layer of iridium is residue from the dust caused by the impact.

*Theory 2 is better is that it is more testable. Since we know nothing about alien big game hunters we can't know what other evidence we might expect to find. Shell casings? But perhaps the aliens used laser rifles. Camp fires and trash? But perhaps they were ecologically conscious enough to clean up after themselves. By contrast, Theory 2 makes three very definite predictions: (1) comets should have high concentrations of iridium, (2) species other than dinosaurs should have become extinct, and (3) there should be a large impact crater somewhere on earth datable to 65 million years ago. All three turn out to be true, but each of them might easily have turned out to be false.*

The real mark of testability is not just that a theory makes predictions that turn out to be true. Rather, it is that the theory makes predictions that *might turn out to be false!* That is, by making clear predictions, the stronger explanation *risks disconfirmation*, i.e. it risks being judged inconsistent with the results of a test. Ironically, the weaker hypothesis, by making few predictions, runs less risk of disconfirmation.

Of course, as with all of the Retroductive criteria, lack of testability cannot by itself disqualify a theory. But it comes close. It is hard to think of widely accepted scientific theories that have not led to further research and useful testing. If a theory were to be accepted despite lack of testability, it would have to be remarkably elegant in other respects.

*Counterexample:*

*Einstein's theory of gravity makes predictions that differ noticeably from the predictions of Newton's theory only when matter is moving at very high speeds or has very high mass. As a result, the theory is extremely difficult to test. The theory was accepted chiefly because of the elegant way in which it eliminates Newton's pesky invisible force acting at a distance. In Einstein's theory gravity is explained as a curvature in space caused by mass. Since space itself is curved, the theory predicts that light from stars will bend as it goes past massive objects, such as the sun. By contrast, Newton's theory predicts that gravity will not bend light, since light has zero mass.) This bending of starlight was eventually observed, but only many years after Einstein's theory had already been widely accepted for other reasons.*

**Applying the Criteria**

To compare two theories, have a template showing the five criteria. The two theories can then be put side by side, and the weaknesses (or, in some cases, the strengths) of each theory can be noted next to the weaknesses (and strengths) of the competing theory. (Hint: it is generally easier to notice and jot down the weaknesses rather than the strengths.) Then look for:

Coincidences – Coincidences are facts that are apparently related in some way, but the facts are explained by separate mechanisms, which fail to account for the apparent relation. For example, when you move into a new house two neighbors show up at your house *at the same time*. If they came together, this makes sense. If they came separately, one to welcome you to the neighborhood and the other to borrow a cup of sugar, then it is a coincidence.

Implausibilities – Implausibilities are causal mechanisms that we dismiss as fictional, including magic, pyramid power, space aliens, witches, demons, etc. Implausibilities also includes (in the category of human behavior) unmotivated actions and unusual behavior motivated only by odd forms of “insanity” not recognized by professional psychologists.

Decisions and choices (especially those that involve cooperation by two or more agents) – By an “agent” I mean someone whose actions, motives, and plans form some part of the causal explanation that makes up the theory. If certain agents occur in two competing theories, but they behave in the same way in both theories, then they do not need to be considered, since their contribution to each theory is the same.

Unexplained facts – There are two kinds of unexplained facts: (1) those that are inconsistent with the theory, and really *need* to be explained, and (2) those that don't really need to be explained, although it is better if they are. Remember that such facts may not even be noticed or considered relevant until after a theory that explains them has been proposed.

Lack of testability – Consider how a theory could be tested. Look for barriers that make testing difficult. Look for ways in which a theory might “weasel out” of a test by revising the speculative facts upon which it is based. Theories that would be consistent with any facts whatsoever should especially be looked down upon.

*Example:*

The murders seem to have stopped now, but the police are still puzzled. Three female dancers who worked at the Pussycat Club were brutally murdered in a single week. All three had red hair, all three were dressed in a black leotard, and all three had just gotten off work, at 1:00 a.m. the night they were killed. In every case their heads had been bashed in by a heavy, blunt object, although the first victim was hit from behind on the left side of her head, the second was hit from in front on the right side, and the third was hit from behind on the right side.

The first dancer, Shirley Knot, was killed on Tuesday night. Her body was found the next morning by a wino who frequently slept in the alley. The wino reported that he had seen a short, ugly man hanging around the alley on the night of the first murder.

The second dancer, Heidi Hole, was killed on Wednesday night. Her body was found about 1:30 a.m. by Juliani, the bouncer of the Pussycat Club. He said he heard a scream from the alley and ran out to investigate. He thinks he may have caught a glimpse of a dark-haired man disappearing over the fence.

The third dancer, Sarah Nade, was killed on Friday night. Her body was found by a policeman who was patrolling the area. Lawrence Jitus, an aide to Senator Jacobson, was in the neighborhood at the time, but he claims he didn't see anything suspicious.

Meanwhile, for lack of any leads, the police have turned their attention to an equally baffling case. The body of that notorious underground figure, Bernie the Basher, was recovered from the river this morning, wearing a black fur hat, and concrete galoshes. He had been shot in the head with an automatic pistol. It is hard to tell how long his body had been in the river. Additional facts, that may or may not matter...

Mr. Jitus, known as Larry, is a tall, handsome, blond-haired man. He is right handed.

Bernie the Basher was a small, sandy-haired man. He was left-handed.

Shirley has had frequent arguments with her boyfriend, who is insanely jealous. Her boyfriend is left-handed and has a scar on his face.

Heidi, who is trying to raise extra money to go to law school, was arrested for prostitution last year. Juliani, the bouncer, is her pimp. He is left-handed, and has dark hair.

According to rumors among the other dancers at the Pussycat Club, Sarah was once the mistress of Senator Jacobson, who will be running for re-election next year. They say he gave her a heart-shaped locket which she always wore around her neck. It appears to be missing.

**THEORY 1.** The intended victim in every case was Sarah. Senator Jacobson hired Bernie the Basher to kill her and steal her locket so she could not involve him in a scandal. He gave Bernie a description of her, but Bernie twice murdered the wrong girl. Angry at Bernie's incompetence, Senator Jacobson then got his aide, Larry Jitus, to kill both Bernie and Sarah.

**THEORY 2.** The three women were killed by three different men for three different reasons. Shirley was murdered by her jealous boyfriend. Heidi was murdered by Juliani when he found out that she was holding back money for her law school tuition. Sarah was murdered by the wino who found the first body. He was not really a wino but a time traveler from the future, and Sarah's locket was a piece of his time machine which he had lost. He had been hanging around the alley waiting for an opportunity to take it back from her.



THEORY 1

THEORY 2

I. Simplicity. Are there any facts that appear strangely coincidental in one theory, but not in the other theory? List as many such coincidences for each theory as you can.

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|--|--|
|  | <ul style="list-style-type: none"> <li>-all girls were killed in the same week</li> <li>-all had red hair and were dressed alike</li> <li>-all murders took place at about the same time</li> <li>-all were killed with a blunt object</li> <li>-all were killed in the same location</li> </ul> |
|--|--|

II. Plausibility. Are there causal mechanisms in either theory that are new or not widely accepted? Are there convincing motives and recognized patterns of human behavior?

|  |                 |
|--|-----------------|
|  | -time traveler! |
|--|-----------------|

III. Naturalness. How many decisions or choices are involved in each theory? Do these agents make elaborate plans or engage in complex behavior? Is there any collusion between agents?

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|---|---|
| 3 agents (Senator, Bernie and Larry)<br>-they engage in some elaborate planning<br>-they are in collusion with each other | 3 agents (boyfriend, pimp and time traveler)<br>-only one does much planning (time traveler)<br>-the other two act pretty spontaneously |
|---|---|

IV. Fecundity. Are there any facts that are unexplained by one theory but explained by the other? Are these serious inconsistencies, or just facts that the theory overlooks? List all you can.

|                |  |
|----------------|--|
| -wino in alley | <ul style="list-style-type: none"> <li>-Larry in neighborhood</li> <li>-death of Bernie the Basher</li> <li>-how Sarah got the locket</li> </ul> |
|----------------|--|

V. Testability. For each theory suggest something else that is likely to be true, if this theory is correct. What action could be taken to determine whether or not it *is* true?

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|---|---|
| -If this theory is correct, then the rumors about the Senator and Sarah are true (although they could be true on the other theory as well). Ask people who knew Sarah if she was often seen with the Senator. Harder to test. | -Assuming the “wino” got his time machine fixed he should no longer be around. Try to find him. Failure to find him will tend to confirm the theory; success will clearly prove the theory false. Easier to test. |
|---|---|

On balance, which do you believe is the better theory? Why?

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| <p>Theory 1 is better. It is weak in involving more planning and collusion, and in being more difficult to test, but it avoids the coincidences and implausibility of Theory 2, and it explains more facts.</p> |
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Notice that many of the facts in this story that may have seemed important initially were not listed on the template. This is because they were adequately explained by both theories. For example, the color of hair reported by witnesses, and the handedness of the suspects, all turns out to be explained in both theories. We are only interested in the features of the two theories on which they differ, i.e. points that make one theory stronger and the other weaker.

*Exercises:*

*Consider the following sets of facts and the two hypotheses purporting to explain those facts. Answer the following questions to decide which hypothesis is better.*

A. The Case of the Pizza-Loving Burglar

Roger was found dead, draped across the couch in Lisa's apartment. He was dressed in Lisa's robe and had been shot in the stomach with Lisa's gun. His clothes were found scattered around the bedroom. There was an uneaten pizza on the coffee table, and Lisa's lipstick and a compact package of Kleenex were on the floor nearby. Lisa was nowhere to be found. Upon questioning, the pizza delivery boy said he delivered the pizza around 8:45. A man had ordered the pizza around 8:00, and a man had answered the door to pay for the pizza. The neighbors reported hearing shots about 8:30, so Roger must have already been shot when the pizza was delivered.

THEORY 1. Lisa shot Roger. Roger broke into Lisa's apartment around 8:00 to steal her jewelry. Once inside, he ordered a pizza, took off his clothes, and put on Lisa's robe. Lisa came home around 8:30 and found Roger there. She pulled out her gun and shot him. Then she put on his clothes. She was still wearing them when the pizza came, so naturally the delivery boy thought Lisa was a man. After paying for the pizza Lisa took off Roger's clothes, scattered them around the bedroom, and left again.

THEORY 2. Lisa's ex-husband Butch shot Roger. Roger was dating Lisa and he was in her apartment with her for pizza and a little love-making. Roger ordered a pizza, and then the two of them got naked. Butch rang the doorbell around 8:30. Roger put on Lisa's robe to answer the door, thinking it was the pizza delivery boy. In a jealous rage Butch forced his way into the apartment. Knowing that Lisa kept a gun in her purse, which she usually left near the door, Butch grabbed the purse, and emptied it to find the gun. He shot Roger. Then he made Lisa get dressed, but while he was waiting for her, the real pizza delivery boy came. Butch paid for the pizza to get rid of him. Then he forced Lisa to leave with him. She may be in real trouble.

B. The Case of the Tormented Twin

It was the maid who discovered the corpse. She came into the drawing room to open the curtains and discovered Mr. Rutherford seated in his easy chair. He was dead. On the table beside him was a bottle of cognac and a small glass. The traces of cognac in the glass were heavily laced with cyanide. An envelope containing traces of cyanide powder had fallen under the chair. An autopsy shows that the poison was consumed sometime between 10:00 and midnight.

After some investigation the following additional facts were also established:

At 7:00 the previous evening Mr. Rutherford had received a visit from a man named Hermann Blunt. Mr. Blunt left around 7:15, apparently quite upset, according to the maid.

At 8:00 Mr. Rutherford made a telephone call to his identical twin brother, Max. The police are looking for Max, but no one seems to know where he is.

At 11:40 the butler heard someone enter (or leave) the house by the side door, but, being off duty, he did not concern himself with it.

Mr. Rutherford's personal diary revealed the embarrassing fact that Mr. Rutherford had once been a member of a secret religious cult that practiced human sacrifice.

THEORY 1. Mr. Rutherford committed suicide. Hermann Blunt knew about the secret religious cult. (Perhaps he had also been a member.) He had been blackmailing Mr. Rutherford to keep the information secret. Unable to meet Mr. Blunt's latest demand, Rutherford had called his brother to try to raise the money, but his brother had refused to help. The only solution was suicide. (Oh, yes. At 11:40 Mrs. Rutherford had opened the side door to let in a man with whom she was having an affair, but that is unconnected to Mr. Rutherford's untimely demise.)

THEORY 2. It was Max who had been blackmailing Mr. Rutherford. Mr. Blunt was just his bag man. In order to stop the blackmail, Mr. Rutherford decided to murder his brother. On the way home from the office Rutherford purchased a package of cyanide. When Mr. Blunt came around, Rutherford refused to pay him. Once Blunt was gone, Rutherford called his brother to tell him to come get the money in person. When Max arrived at about 11:40, Rutherford offered him a poisoned drink. Once Max was dead, Rutherford changed clothes with his brother and slipped quietly out of the house while everyone was asleep, leaving the packet of poison under the chair as if it had fallen there by accident. The corpse in the chair is really Max!

### C. The Case of Clowns on Motorcycles

The circus is in town, and posters have been put up all over town advertising their famous clowns-on-motorcycles act, which concludes the show.

At precisely 3:47 on Thursday afternoon, someone dressed as a clown—white face, red nose, blue hair—walked into the Stop Gap convenience store on West 9<sup>th</sup> and shot the clerk. He then left without taking any money from the cash register. He did, however, take a bag of potato chips, a bar of soap, and a box of Hefty trash bags—items that he had selected before approaching the counter. We know all this because the security camera caught it all on tape.

Witnesses in the parking lot tell us that the clown drove away from the Stop Gap on a Harley-Davidson motorcycle. The bike was later found abandoned at a truck stop twenty miles away. It had been stolen from the circus parking lot. It belonged to a member of the Hell's Angels Motorcycle Club who had been attending the performance at the circus along with other members of the gang. The other members of the gang assure us that he stayed for the entire performance from 3:00 to 5:00 that Thursday.

Rustam Assiz, the owner of the convenience store, tells us that the clerk, Charlie, was a college student who will be missed in the community. He was a handsome, likeable young man who was expected to go far.

THEORY 1. A clown from the circus killed Charlie. Having a hankering for some potato chips, he “borrowed” a bike from the circus parking lot and drove to the Stop Gap. Having selected his potato chips and a few other incidental items, he realized that he didn’t have any money with him in his clown costume, having left his wallet in his regular clothes. However, he did have a gun, which he used in his act. Normally the gun would only be loaded with blanks, but this morning it was accidentally loaded with real bullets by mistake. The clown didn’t really intend to shoot Charlie: he was just trying to frighten him so he could take the potato chips. When the gun went off, killing Charlie, the clown fled in panic.

THEORY 2. Rustam, the owner of the Stop Gap, shot Charlie. Charlie was having an affair with Rustam’s wife. To disguise himself from the security camera, Rustam made himself a clown costume. He drove his old pickup to the truck stop. Then he hitched a ride down the highway to the circus. There he put on his clown costume and stole a motorcycle. He rode the motorcycle to the Stop Gap, where he shot Charlie. Then he rode to the truck stop where he left the bike. In the truck stop’s restroom he used the bar of soap to wash off his white-face, and he used a Hefty bag to dispose of the clown costume. Then he got back in his pickup and drove home.

## Retroductive Fallacies

### Group 12: False Cause Fallacies

**Arcane Explanation** - The argument unnecessarily proposes an explanation that appeals to causal mechanisms that are not currently or generally accepted, or to the activities of entities or beings not generally thought to exist

**Non Causa Pro Causa** - The argument offers an explanation that confuses correlation with causality. One event is cited as the cause of another, but, while there may actually be a connection between the two events, the hypothesis mis-locates it, either making the effect into the cause, or treating as cause and effect two events that are independent results of a common cause.

**Post Hoc Ergo Propter Hoc** - The argument offers an explanation that confuses co-occurrence with causality based on a temporal ordering of events: A comes before B, so A causes B. In fact, the co-occurrence of the two events is likely to have been merely coincidental, or the result of some further causal factor.

**Hypothesis Contrary to Fact** - From a statement of fact, the argument draws a counterfactual claim (i.e. a claim about what *would* have been true if the stated fact were *not* true.) The argument falsely assumes that any state of affairs can have only one possible cause.

**Gambler’s Fallacy** - The argument assigns a probability to a random event, or projects the future occurrence of the event, based on the notion that the past history of that type of event has some influence on its probability or on its future occurrence.

## Group 13: False Report Fallacies

**Over-reporting the Facts** - The argument proposes an explanation for a “fact” that is nonexistent, or the existence of which is doubtful. The arguer uncritically accepts as true the occurrence of events that are legendary or mythological, mere rumors or exaggerations, and in any case uncorroborated and unrepeatable.

**Under-reporting the Facts (Suppressed Evidence)** - The argument proposes an arcane explanation for a fact that appears mysterious only because not all of the relevant accompanying facts have been reported. The additional facts suggest a perfectly ordinary explanation. (No exercises)

## Group 14: Retroductive Circularities (Circular Explanations)

**Appeal to Mystery** - The argument proposes, as an explanation, the claim that there can be no explanation, i.e. that the fact to be explained is unexplainable.

**Vacuous Explanation** - The argument proposes an explanation, but the mechanism proposed does not have a clear meaning, other than merely “whatever explains this phenomenon.”

**Canceling Hypotheses (Conspiracy Theory)** - The argument defends one hypothesis by proposing another hypothesis to explain why certain events predicted by the first hypothesis did not occur. The second hypothesis cancels or undermines the predictions made by the first hypothesis.

**Infinite Regress** – The argument proposes an explanation, but the mechanism proposed stands just as much in need of explanation as the original fact to be explained, and indeed stands in need of the same kind of explanation. So it is tempting to apply the explanation to itself.