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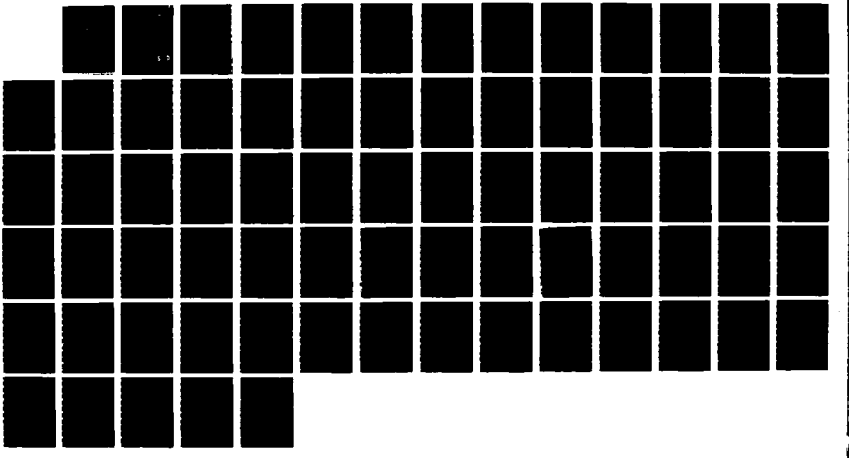

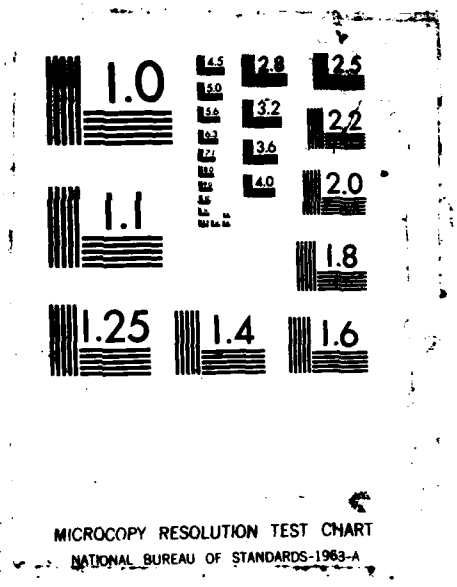
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Types of Explanations

Alex Kass and David Leake
YALEU/CSD/RR #523

March 1987

YALE UNIVERSITY
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Many people in AI want to use explanations in their work, but nobody (including us) knows enough about them. Although explanation has been the foundation of much AI research, little attention has been paid to two fundamental questions one would like to be able to answer about explanation: What are the kinds of things that need to be explained and what are the types of explanations?

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Abstract

Many people in AI want to use explanations in their work, but nobody (including us) knows enough about them. Although explanation has been the foundation of much AI research, little attention has been paid to two fundamental questions one would like to be able to answer about explanation: What are the kinds of things that need to be explained and what are the types of explanations?

This report is an attempt to map out that territory by developing a categorization scheme that covers a substantial variety of anomalies and explanations. We have collected a large group of real-world explanations and studied their similarities in order to understand what categories they fall into. In this paper the anomalies which need to be explained are divided into three broad classes: intentional, social and material anomalies. We discuss the three classes, and present the different kinds of explanations that can apply to each.

Contents

1 Introduction

Many people in AI want to use explanations in their work, but nobody (including us) knows enough about them. (For examples of work on explanation-based learning, see [Hammond 86], [Mooney and DeJong 85], [Segre and DeJong 85], [Pazzani, et. al. 86], [Lebowitz 86], [Mitchell, et. al. 85].) This paper evolved out of Yale work on case-based explanation [Schank 86] and in particular our work on explanation-based story understanding ([Kass, Leake and Owens 86], [Kass 86], and [Leake and Owens 86]), in which we are building a system that understands anomalous events by retrieving old explanations from its memory and adapting them to new events. In order to test our theories of retrieval and adaptation it will be necessary for us to endow our system with a large store of pre-established explanations to serve as the raw material for it to draw on. When we set about building this library of explanations, we discovered that despite the use of explanation in many AI systems, little attention has been paid to two fundamental questions one would like to be able to answer about explanation: What are the kinds of things that need to be explained and what are the types of explanations?

A lot of work has been done on the philosophical analysis of explanation, especially scientific explanation. (For representative work, see [Hempel 65],[Davidson 63], [Taylor 70].) We are not interested in doing a philosophical analysis of explanation in this paper, but rather a psychological one. We're not going to address such grand questions as "what does it mean to explain?" or "what types of inference chains formally suffice to explain a given phenomenon?" That sort of work may eventually have some role to play in a computational theory of explanation, but what we're interested in here is simpler. We just want to identify the types of rules people actually appeal to when confronted with anomalies. Since explanation is central to our research, it seems important to begin by examining a large group of explanations: if we want to conquer the explanation problem we have to know what real-world explanations are like. Toward this end, we have started collecting explanations from friends and colleagues, and are attempting to categorize them. This paper is a report on what we have found. (The body of the paper presents our analysis. Appendix B contains the explanations we collected.)

Of course, simply categorizing the explanations we have come across does not begin to constitute a complete theory of explanation, but we think it is a necessary first step. There are many ways a categorization can aid investigation of explanation-based systems. For example, knowledge of the kinds of explanations will provide a standard for judging

how well AI systems explain, since the categorization helps us determine which types of explanations our systems can deal with, and which they cannot. A categorization also helps us devise a representation for explanations, since it summarizes the kinds of knowledge that must be captured in the representation. Finally, a categorization of explanations ought to be useful for indexing explanations in memory: If an explainer can determine what type of explanation it wants in a given situation, using the explanation type as an index should constrain the search for candidate explanations in memory.

Thus there are strong practical reasons for trying to understand the types of explanations. This report is an attempt to map out that territory, so that in the future we (and other researchers) can explore more deeply.

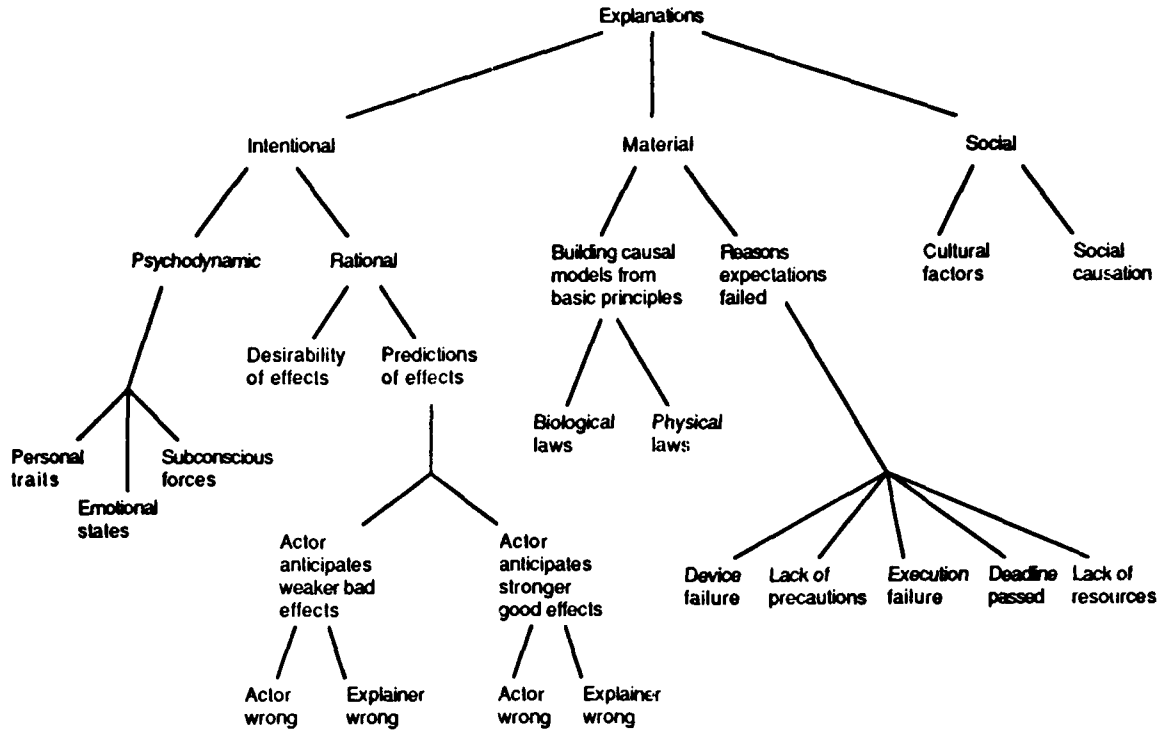

Figure 1: A hierarchy of types of explanations

2 Overview of the categorization scheme

Our categorization of explanation types is hierarchical. At the top level we have divided the world of anomalous events into three types of phenomena — those involving intentional actions, material forces, and social forces. For the most part, a particular anomaly can be placed in one of these categories or another on inspection. For example: a person's decision to drop out of school is intentional, an unexpected snowstorm is caused by material forces, and an increase in the crime rate involves social factors.

However, sometimes more than one kind of explanation may be applicable to a given anomaly: if we wonder why the government wastes money, we might consider the anomaly as an intentional problem (which would correspond to an explanation like "they think they can solve every problem by throwing money at it") or as a social one ("the interaction of branches of government causes huge overhead"). Also, explanations of different types can often combine to make larger, more complex explanations. This happens when an explanation reduces an anomaly of one type to an anomaly of another type that must then be explained. For example, someone might wonder why a vase fell off a ledge (a material anomaly). The explanation might be *somebody pushed it*, which takes care of

the original material anomaly but also suggests a new, intentional anomaly concerning why someone would want to break the vase.

These three major divisions and their respective subdivisions are depicted in Figure 1. We can summarize the intentional, material and social branches of the categorization tree as follows:

- **Intentional Explanations:** Once an anomaly has been categorized as involving an intentional action by an institution or individual, there are two possibilities for the type of explanation: the anomaly can either be explained in terms of rational decision-making (where an actor decided to act after consciously weighing the alternatives), or (for human actors) in terms of psychodynamic factors. Explanations in terms of rational decision-making identify the discrepancies between the explainer's and actor's view of the relative importance of good and bad effects of the action, to show why the actor chose to act in a way different from what the explainer expected. Psychodynamic explanations identify unconscious factors that influenced the actor's behavior.

- **Material Explanations:** For anomalies involving material properties of the world, there are two basic modes of explanation. If the anomalous event contradicts an active expectation of the explainer, it is explained by identifying aspects of the material situation that made the expectation fail. Such aspects can include device problems, lack of precautions by some actor, planning/execution failure by the actor, a deadline being missed, or the lack of a resource necessary for the expected event to take place.

  If the anomalous event does not relate to any of the explainer's active expectations, an explanation must build up from basic laws a causal chain that explains the event. These chains can involve biological or physical laws.

- **Social Explanations:** Social explanations involve stereotyped group behavior or behaviors that result from the interactions of many independent actors whose actions are not coordinated. This class of explanations is closer to material than intentional explanations, since it does not involve plans and goals. We explicitly exclude from this class the explanations of goal-directed actions by institutions, which we consider to be subsumed by the category of *intentional* explanations. Social explanations make reference to principles of social causation (roughly analogous

to the physical laws used to explain material anomalies) such as those of economics or the *Peter Principle.*

In the following sections, we consider each of these classes in more detail, showing how they apply to a wide range of explanations. Most of our examples were gathered at the Yale AI Project, but some were collected from magazine and newspaper articles, and a few were made up to illustrate particular points about our theory.

3 Explaining intentional actions

Explanations of why an actor behaved in an unexpected way are among the most ubiquitous and the most interesting. Most intentional actions that others perform are explained assuming that the actor was acting in a rational fashion, but with a different view of the situation than we expected. We will look at those at some length in the section on rational actions. Some intentional actions aren't explained comfortably by explanations appealing to rational decision-making; these require what we call *psychodynamic explanations*, the kinds of things that professional and amateur psychiatrists develop to explain mysterious behaviors. This is the subject of the following brief section.

3.1 Psychodynamic factors

For some human actions, explanations in terms of rational decision-making are not satisfying. For example, while people who smoke may try to rationalize their actions, continual smoking seems more an unconscious drive than conscious decision-making. Similarly, people who fail to fasten seat-belts may make arguments about choosing comfort over safety, but other factors, such as laziness, or aversion to facing the real possibility of an accident are often involved. Psychodynamic explanations are those in which we explain an actor's anomalous behavior by appealing to some aspect of his or her psyche (other than conscious preferences, which are considered part of rational-decision explanations).

A great deal can be said about why people act in odd, self-destructive ways; much of the psychiatric enterprise is concerned with answering this question. Obviously, we cannot attempt a thorough analysis of these theories here. But since some of the explanations we collected did appeal to this type of causation, it is probably worthwhile to devote a little space to this topic.

There seem to be three kinds of psychodynamic factors that show up in many people's explanations; personal traits (such as shyness or addiction to sweets), emotional states (such nervousness or being in love), and subconscious forces (such as repression or sublimation).

3.1.1 Personal traits

An explanation of why an actor did something may refer to some aspect of the person's personality, or even biology.

- **Anomaly:** Why didn't Joe call Mary for a date even though he was lonely and suspected that she cared for him?

  Explanation: He is an extremely shy person.

- **Anomaly:** Why is Mary always taking her clothes off in public?

  Explanation: She is an exhibitionist.

- **Anomaly:** Why does John smoke cigarettes even though it annoys his friends and is giving him a chronic cough?

  Explanation: He is addicted to them.

3.1.2 Emotional states

Sometimes people's states cause them to act irrationally.

- **Anomaly:** Why did Mary hit her son even though she does not believe in corporal punishment?

  Explanation: She could not control her anger.

- **Anomaly:** Why does John continue to call Mary even though she treats him badly.

  Explanation: He is in love with her.

- **Anomaly:** Why did Dwight pitch so badly in the World Series when he was so good the rest of the year?

  Explanation: He was very nervous.

3.1.3 Subconscious forces

An important kind of explanation that is applied to human behavior involves subconscious forces. Such explanations are the kinds of things that some psychiatric theories are made of. People vary quite a bit with regard to how appealing they find these explanations; some people rarely use them, while some people attempt to explain everything everyone does with this way. Two examples follow:

Repression

Repression involves some part of the mind actively keeping some thought from reaching the conscious level. For example, if an actor repeatedly forgets to call the dentist to make an appointment, it may be that some part of him is repressing the thought of calling the dentist due to fear of the drill.

Sublimation

Some people find it satisfying to explain certain desires as sublimated versions of desires which must not be acted upon. For example, if an actor plays an abnormal amount of tennis, one such explanation of his playing would be that for him tennis is a sublimated version of the desire to sleep with his best friend's wife.

3.2 Explaining rational action

When an intentional action seems anomalous, it is generally because the actor's model of the world somehow differs from what we expected. The role of an explanation in this case is to make a hypothesis about the difference in world-view.

Understanding an actor's actions must be done within a model of decision-making. Rational decisions are made by assessing the positive effects of performing a given action and balancing them against any negative side-effects. If the positive effects outweigh the negative effects, the action is worthwhile to perform. In order to predict whether some other actor will choose to perform an action, it is necessary to simulate that actor's decision-making process. This involves predicting the positive and negative effects the actor anticipates, and estimating the relative importance that the actor will assign to those effects. Since a given effect may be given different weight by people with different goals and goal-orderings, our model must take into account not only the balancing of objective effects, but also the different relative importances that those effects will have for any particular actor.

In other words, to anticipate an actor's decision we must use our knowledge of both the actor *and* the situation, in order to put ourselves in his place, as it were, and ask ourselves what we would do. Our knowledge of the situation is important since we need to compare the good effects against the bad effects, but our knowledge of the actor's

personal goals is also crucial since that is what determines how much weight to give to each good and bad effect. Since knowledge of both actor and situation play a role in predicting behavior, it follows that either one can be involved in explaining expectation failures.

At the highest level there are four different ways that an actor could decide in favor of performing the action when we expected him to decide against it: It could be the case that the actor and the understander share the same model of the situation but place different subjective evaluations on the various effects of the action (the actor may care more about the positive effects of the action, or may care less about the negative effects, or both); or the actor may predict more good effects than the explainer does; or the actor may predict fewer bad effects than the explainer does. Here are some examples to illustrate these cases:

Actor cares about positive effects more than understander

- **Situation:** John heard that Twisted Sister would perform in his town but that tickets would sell out quickly. He camped out three days in the snow in front of the ticket office.

  Anomaly: Why'd John go to all that trouble to get tickets?

  Explanation: He's a rabid Twisted Sister fan who thinks that seeing them is worth whatever effort it takes.

Actor cares about negative effects less than understander

- **Situation:** John heard that Twisted Sister would perform in his town but that tickets would sell out quickly. He camped out three days in the snow in front of the ticket office.

  Anomaly: Why'd John go to all that trouble to get tickets?

  Explanation: He's unemployed so he's got time to waste, and he's from northern Canada, so he's comfortable out in the cold.

Actor anticipates weaker bad effects than understander

- **Situation:** John's teacher told the class that late papers would be given half credit. Although John had almost finished the paper, he didn't bother to bring it to class the day it was due.

  Anomaly: Why did John turn in the paper late, even though he knew that the teacher would only give half credit for it?

  Explanation: He didn't think the teacher would really take off the points.

Actor anticipates stronger good effects than understander

- **Situation:** John used to shop at a discount supermarket, but he switched to a more expensive one.

  Anomaly: Why'd John change to a more expensive market?

  Explanation: They were offering double coupons.

. . .

For each explanation we might give when we are surprised by an action, there are corresponding reasons we might be surprised by an actor's failure to perform an action that we predicted. Examples follow:

Actor ranks effects differently than understander

- **Situation:** John was a bright young man whose family had been saving up so he could go to college and have a successful career, but he decided to become a surfer in California instead.

  Anomaly: Why didn't John go to college?

  Explanation: He thinks that making money is less important than having a pleasant lifestyle.

Actor anticipates weaker good effects than than understander

- **Situation:** Most of the students in beginning calculus had crammed all night for the midterm, but John went to the movies instead.

  Anomaly: Why didn't John cram for the test?

  Explanation: He thought it was too late for cramming to make any difference.

Actor anticipates stronger bad effects than understander

- **Situation:** Mark, an enthusiastic Twisted Sister fan, heard they would perform in his town and that the concert was expected to sell out quickly. He considered camping out the night before tickets went on sale, but decided not to.

  Anomaly: Why didn't John camp out to get concert tickets?

  Explanation: He'd heard that gangs had threatened to rob the people camping out.

. . .

In the following sections, we will look at the factors that affect each of these judgements, and discuss possible sources of discrepancies between the effects we predict, and also between our evaluations of their relative importance.

3.2.1 When the actor's predictions of effects are surprising

The way an actor acts may be quite different from what we expect if his evaluation of the circumstances differs from ours. We have already stated the four possibilities for such discrepancies:

- Actor anticipates weaker bad effects than than understander
- Actor anticipates stronger good effects than understander
- Actor anticipates weaker good effects than than understander
- Actor anticipates stronger bad effects than understander

In any of these differences, the actor or understander (or both) may be wrong about the real effects of the action. There are three main causes of such errors:

Outdated information

- **Anomaly:** Why did he leave for shopping so late that the store would probably close before he got there?

  Explanation: He hadn't heard that they'd stopped having late hours on Saturdays.

- **Anomaly:** Why can data processing schools recruit so effectively, even though there isn't a big demand for low-level computer workers?

  Explanation: People don't know that the market for those jobs is now saturated.

Information from inaccurate source

Source misinformed

- **Anomaly:** Why did he go to a store with such high prices?

  Explanation: Someone told him that the prices were competitive.

Source deliberately gave false information

- **Anomaly:** Why did the U.S. wait so long to take action when the Shah of Iran was about to be overthrown?

  Explanation: Its sources of information in Iran were all affiliated with the government, so they tried to make the Shah seem more popular than he was.

Ignored information

- **Anomaly:** Why did he borrow money at an enormous interest rate?

  Explanation: He didn't read the fine print.

- **Anomaly:** Why do kids start smoking?

  Explanation: They don't think about the consequences for health.

3.2.2 When the actor's desires for effects are surprising

Even when an explainer has the same expectations about an action's results as its actor does, they may disagree on whether it is worthwhile to perform the action. Decision-making is the evaluation of different objective effects with respect to particular goals and goal-orderings; we will now consider how different goal orderings arise. There are four main categories of goal ordering differences:

1. The actor considers one of his goals less important than we expected.

   Example: A teenager may be fairly unconcerned about how he does in school.

2. The actor considers one of his goals to be more important than we expected.

   Example: A collector of bubble gum comics may sell his house to buy the one that completes his collection.

3. The actor lacks a goal we expected him to have.

   Example: A person may have no desire for a high-intensity career.

4. The actor has a goal we didn't expect him to have.

   Example: A con man's victims don't originally realize that he has the goal of swindling them.

When we explain unexpected behavior in terms of a conflict between the actor's goal ordering and our expectations, we attribute the observed behavior to one of the above types of priority difference. However, this is not a satisfactory explanation by itself: an explanation based on goal priority must also show how the unusual precedence arose.

There is a limited set of influences that cause the above orderings to develop; an explanation of goal ordering must connect the ordering to them. (An explainer can also direct its search for explanations in memory by asking a series of questions based on them.) The following aspects of an actor's background are potentially-relevant to the development of his goal orderings.

Goal acquisition

Group patterns: (both for individual goals, and for general principles, such as short-term sacrifice for long-term gain): Group patterns are trends that we have observed in goal-orderings within a group, even though we may not know what circumstances cause a particular individual to conform to the pattern. Group pattern explanations of goal-orderings are what we rely on when we explain a goal ordering in terms of a stereotyped grouping. A few examples follow:

- **Anomaly:** Why don't kids respect their teachers?

  Explanation: Kids never respect authority.

- **Anomaly:** Why do they borrow so much money?

  Explanation: Americans always live above their means.

- **Anomaly:** Why do teenagers have so many car accidents?

  Explanation: Teenagers take wild chances.

Background: Explanations in terms of an actor's background connect an observed goal-ordering to something that was instilled in the actor by his family or by society.

Background factors include:

- *Examples/role models*: We often assume the behaviors of those we admire. For example, a child may try to be like a television hero.

- *Upbringing*: Parents try to instill certain values, like honesty and respect for hard work, in their children. However, the values determined by upbringing are not restricted to values that those in authority tried to instill. For example, parents who try to teach discipline by strictly punishing their child may teach him to put a high value on avoiding detection, rather than on behaving well.

- *Social values*: Society reinforces certain values by rewarding them; behaviors that are successful in a social context (*e.g.*, being aggressive in tough neighborhoods) are strengthened.

These factors are reflected in the following examples:

- **Anomaly:** Why is the boy taking drugs?

  Explanation: His parents always drank to escape their problems.

- **Anomaly:** Kamikaze pilots going on suicide missions.

  Explanation: Kamikaze pilots are taught to value their country above their lives.

- **Anomaly:** Why do people pretend they're younger than they are?

  Explanation: Our culture puts a premium on appearing youthful.

Goal re-ordering

Devaluation of things you have, and desire for what you don't: People are seldom content with what they have; they always want to improve their perceived condition. But since it's hard to evaluate what constitutes a real improvement, people often base their ambitions on others: they strive for things that others have and that they lack. Things that they have are treated as less important, since they take them for granted. This may make someone pursue a goal that seems minor, while sacrificing a more important goal for which achievement is easier. (This factor is expressed by the saying *The grass is always greener on the other side of the fence.*)

- **Anomaly:** A French person thinks it's a special treat to eat at MacDonalds.

  Explanation: If you're used to eating carefully-prepared food, fast food can be appealing as a novelty.

- **Anomaly:** Americans want to be tanned, and Indians want to be pale.

  Explanation: People always want to change appearance.

Resignation to blockage of higher-level goals: When an actor becomes resigned to a goal being blocked, he may abandon it and reorganize his goals in light of his judgement of which goals are possible to achieve. This phenomenon is seen as people grow older: many children have very impressive goals that they abandon when they grow older and see how hard the goals would be to achieve.

- **Anomaly:** Someone drops out of school to get a dead-end job.

Explanation: He thought he wouldn't graduate anyway, so it wasn't worth continuing.

- **Anomaly:** A person who can't afford enough food buys expensive clothes.

  Explanation: If you're accustomed to having little food, it doesn't make much difference to pass up a chance to improve the situation in the short term.

Devaluation of long-term goals in favor of short-term ones: People frequently place a higher priority on current gratification than on long-term goals, despite their view of the goals' relative merits. Companies also sometimes sacrifice valuable long-term improvements in order to maximize short-term profits.

4 Explaining material anomalies

Sometimes we observe anomalies that seem unconnected to intentional behavior or social forces. For example, we do not try to explain the rain in terms of goals it might serve or the social forces that bring it about: we seek meteorological data on how physical factors cause it to take place. The eventual explanation may involve social or motivational factors (for example, farmers may have responded to an extended drought by seeding the clouds), but to build such an explanation, we must know the physical reasons (in this case, that the rain was caused by seeding the clouds). To reach more distant factors, we must first understand the material causes.

Explainers view an anomaly in material terms when the failed expectation arises is one of device performance or physical interactions. For example, a flat tire or a traffic jam could be a material anomaly if we wonder what caused the tire to rupture, or why the flow of traffic was impeded. An expectation failure like someone's absence from a planned meeting could be viewed either as a physical anomaly (*what prevented him from being here?*) or an intentional one (*why did he plan not to be here?*)

After the material causes for an anomaly have been diagnosed, we can trace back further to find other significant factors. For example, our final explanation of a traffic jam could be in terms of some physical cause (*e.g.*, one lane of traffic is blocked, forcing cars to funnel into a single lane), in terms of social patterns (*e.g.*, everyone in France going on vacation on August 1), or even intentional ones (*e.g.*, in order to get the public to vote for him, the candidate who has been calling for better roads has sabotaged the roads before the election).

Explanations that focus on material factors of a situation fall into the following categories:

- Using basic principles to build up causal models in domains where the explainer lacked such a model or was using a very vague model. This is the kind of thing physical scientists sometimes claim to do, and the kind of explanation that philosophers of science have studied the most intensively:

    1. biological laws
    2. physical laws

- Explaining contradicted expectations in terms of unanticipated factors.

    1. device failure
    2. lack of precautions
    3. *execution failure*
    4. missed deadline
    5. lack of resource

The following sections present examples of explanations in each of these categories. (First-person accounts have been edited.)

4.1 Using basic principles to build up causal models

4.1.1 Biological laws

- **Situation:** John was in his 30's. His health seemed fine.

  Anomaly: Why'd he have a heart attack?

  Explanation: Heart attacks are caused by stress.

- **Anomaly:** Why'd he get pimples?

  Explanation: Pimples are caused by eating chocolate.

- **Anomaly:** I was spending a quiet evening with Suzie, who had had a difficult day. We were sitting on the bed and she was hugging a pillow to her breast. I asked her why women do that.

  Explanation: My explanation was that it affected the level of some hormone associated with nursing; that would make holding things in that position feel good. The pillow is roughly baby sized, and the phenomenon only worked in a narrow range of positions.

4.1.2 Physical laws

- **Anomaly:** Along a causeway there are large round brick columns. Around these columns there was snow. However, for about 1 foot outward from the base of each column all the way around, there was no snow.

  Explanation: The first explanation we came up with was that the wind hits the column and then blows up, down, and around it. The wind that is blown down blows the snow away from the column. If the wind comes from different directions at different times, the ground will be clear all the way around the column.

- **Anomaly:** I never seem to be able to get the door in Alex's Honda to close completely. Alex, on the other hand, never seems to have this problem.

  Explanation: It struck me then that the problem wasn't me, but the second person to close a door can't do it. I decided that it must be air pressure - when the car is sealed save one door, the pressure in the car keeps that last door from closing all the way. When another door is opened, the air has another place to go.

- **Anomaly:** (From the *New York Times*): After dashing down the long flight of stairs to the subway, a woman just missed her train and was exasperated. A guard informed her that she shouldn't worry as he felt a local coming soon.

  Explanation: The guard stated that "You can always tell which train is coming by the strength of the breeze down the platform. The local gives off a weak breeze, the express a strong one."

4.2 Explaining expectation failures

4.2.1 Device failure

- **Anomaly:** Why doesn't my computer work?

  Explanation: Computers don't work if it's too hot.

- **Anomaly:** The lightbulb in the hall blew for the second time in a month.

  Explanation 1: We must have put in an old bulb.

  Explanation 2: It was a 100 watt bulb in a closed container and that heat blew it.

- **Anomaly:** Yesterday, walking to my car, I approached the automatic parking lot gate to my parking lot. The gate is the type where you insert a plastic card to get in, and that automatically opens when you approach the gate in your car to get out.

  At a distance of about 50 feet I noticed that the gate rose about half way up and went back down again.

  Explanation 1: I saw a government police car parked in the distance in a place where cars do not usually park. I wondered if the police car had something to do with the gate's behavior. Did they have some device that triggered the gate?

  Explanation 2: I then wondered if I had not in some way triggered the gate in my approaching it. Was the parking gate triggered by some sort of metal detector?

  Explanation 3: It had been raining heavily that day and perhaps the rain caused some electrical problem in the gate.

4.2.2 Lack of precautions

- **Anomaly:** This morning, watching the Reuters newswire on TV, one of the headlines at the beginning read "American TV network reporter feared kidnapped in Beirut." Immediately, Jerry Levin, CNN's reporter in Beirut, came to mind, not as a conscious prediction, but just sort of idly.

  Explanation: When I first noticed that he had been posted as Beirut bureau chief for CNN, I remember thinking that it was a bit risky for a Jew to take that assignment. Sure enough, it turns out that it's Jerry Levin who is missing and believed kidnapped.

- **Anomaly:** The milk spoiled.

  Explanation: It wasn't kept cold.

- **Anomaly:** Why'd the plant die so soon?

  Explanation: It died because you didn't water it enough.

- **Anomaly:** Why did the Chernobyl nuclear power plant explode?

  Explanation: The safety systems weren't engaged.

4.2.3 Execution failure

Sometimes a problem arises because of unintentional failures when carrying out a plan.

- **Anomaly:** Why was he late?

  Explanation: He took a wrong turn on the way here.

- **Anomaly:** Why didn't the souffle rise?

  Explanation: The oven wasn't set to the right temperature.

4.2.4 Deadline passed

In time-dependent phenomena there are often critical points by which time some action must be performed. Lack of intervention in time can result in an undesirable outcome.

- **Anomaly:** Why couldn't he get one of the cheap plane tickets?

  Explanation: *He didn't buy his ticket until after the offer expired.*

- **Anomaly:** Why did the milk spoil?

  Explanation: It wasn't drunk before the expiration date.

4.2.5 Lack of resource

When processes lack the resources they require, their outcomes may be changed. Plans and mechanisms may be affected by resource problems:

- **Anomaly:** Why'd the plant die so soon?

  Explanation: It didn't get enough sunlight.

- **Anomaly:** (From the *Washington Times*): Whenever Dan Rather leaves New York to do a broadcast, his gray hairs seem to disappear.

  Explanation: The lighting isn't as good in other studios. Studio ceilings outside New York are so high that the overhead lights don't catch the gray hairs.

5 Explaining social anomalies

Social explanations describe non-intentional group behavior, and give reasons for phenomena in terms of a social context. One class of examples is traditional group behavior for particular cultures, such as the French always having wine with their meals. Another concerns behaviors that result from the interaction of many individual intentional factors, when the factors have no agreement to serve the goals of the group as a whole. A classic example of this type of social causation is the economist's description of the "invisible hand" that organizes a free-market economy. Another example arises from considering government waste as a social behavior, and explaining it in terms of inefficiencies caused by many individual agencies acting in a non-cooperative way.

As with material anomalies, the original classification of anomalies as social ones is not immutable. We could also look at the government as a single actor, and see government waste as a matter of intentional behavior. In this case, a possible explanation is that the government is wasteful because it thinks that problems can be solved by throwing money at them.

However, there are still anomalies for which we first seek a social explanation, and events that we are content to characterize at a social level. A few examples follow.

5.1 Cultural factors

- **Anomaly:** Why does France have a low alcoholism rate?

  Explanation: France has a low alcoholism rate because alcohol isn't regulated as something special.

- **Anomaly:** Why does France have a high alcoholism rate?

  Explanation: France has a high alcoholism rate because alcohol's so easily available.

- **Anomaly:** Why do young men in France smoke so much?

  Explanation: Being in the army makes you start smoking.

- **Anomaly:** Why is the crime rate increasing?

Explanation: Contempt of society and its rules is trendy, and so kids grow up thinking that some types of crimes are actually acceptable.

5.2 Social causation

- **Anomaly:** Why was X mugged?

  Explanation 1: People are mugged because they look vulnerable.

  Explanation 2: People are mugged because they display their valuables.

  Explanation3: People are mugged because they go into dangerous areas.

- **Anomaly:** Why is the crime rate increasing?

  Explanation 1: Rambo dolls and other war toys are a bad influence on kids and make them more militant.

  Explanation 2: Increasing poverty makes people more desperate.

- **Anomaly:** Why is the exchange value of the dollar falling?

  Explanation: Excessive importing by the U.S. increases the supply of dollars abroad, which makes the price drop.

6 Analyzing some examples

The previous sections have presented a categorization of the types of explanations, with examples selected to demonstrate as simply as possible the different explanation types. While most real-world examples may not fall as obviously into the different classes, we believe that our categorization will account for them as well. To illustrate this, in this section we will apply our categorization to a number of more difficult examples.

6.1 Why did Voyager get so much publicity?

After Voyager made the first non-stop flight around the world without refueling, readers of the net space computer bulletin board wondered why the flight received so much more publicity than other flights that set aviation records. There are two perspectives that we might take on this question: we could look at the publicity from an intentional viewpoint, trying to ascribe the publicity to conscious decision-making, or we could look at it as something that arose in an uncoordinated fashion from many individual actions, *in which case a social explanation is appropriate. We look at a few possibilities below:*

- **Social Explanations:**
  1. **Cultural Factors:** Our culture makes into heros the individuals associated with aeronautical breakthroughs (*e.g.*, Lindbergh or the astronauts).
  2. **Social Causation:** Americans might have wanted good news to balance depression about international problems of the U.S. (*e.g.*, terrorism against Americans overseas). Editors everywhere could have independently responded by giving prominence to news on Voyager.
- **Intentional Causes:** An intentional explanation depends on viewing the publicity as the result of a single actor. One way to find an actor responsible is to see who would profit from the publicity. This which means that we assume that the explanation will be a rational one. Reasons for a rational explanation are
  1. **Predictions of Effects:** Publicity about Voyager provides entertainment and distraction, and perhaps increases national pride. (National pride is a goal of the government, which suggests the government as possible actor.) However, pride and distraction alone don't seem enough of an explanation

2. **Desirability of Effects:** Since the Voyager landing took place during the initial scandal of the U.S. selling arms to Iran and diverting money to the contras, there was a special reason for the government wanting the public distracted.

This suggests a (slightly paranoid) explanation for the publicity: the government valued the distraction much more strongly than we would have thought, and arranged the publicity to decrease interest in the scandal. This explanation was actually discussed on net.space.

6.2 Why doesn't my electronic mail get delivered?

The failure of e-mail to arrive is a material problem. Since mail problems contradict our expectations, possible explanations are reasons for the expectation failure:

- **Material Explanations:**
  - **Device failure**, such as a head crash on a disk where mail was spooled.
  - **Lack of resources**, such as a power failure or insufficient disk space to spool a message.

However, we could also take one of these immediate causes as a starting point for further investigation. We might find one of the following reasons for deficient software:

- **Social Explanations**
  1. **Cultural Factors:** Reliability may not be considered important by the user community, resulting little effort to have a good system.
  2. **Social Causation:** The mail system might have been a group project where each component's design was based on assumptions that interacted badly with the assumptions of the others.
- **Intentional Causes:** Why did the programmer decide not to debug the mail system completely?
  1. **Predictions of Effects:** Perhaps he didn't know the system was buggy, or thought the bugs were more minor than they really were.

2. **Desirability of Effects:** The programmer might have valued user difficulties very lightly compared to the advantages of finishing the program.

The above example shows that even when the immediate explanation of an anomaly calls for a particular type of explanation, elaboration may bring in a range of other factors.

6.3 Why didn't the manager use a pinch-hitter?

Sports fans are always second-guessing their teams' maneuvers and wondering why they did what they did. We'll look at an example from baseball. Suppose that it is the bottom half of the eighth inning and the home team is leading by a single run with no outs and a man on second. It is the pitcher's turn at bat. A common move here would be to put in a pinch-hitter to try to score the run, but in this particular case the manager doesn't do so. A fan might find this anomalous and try to come up with an explanation. A great number are possible.

This anomaly seems *prima facie* to be an intentional action, rather than something that will yield easily to explanation in terms of material or social forces. One might be able to think of some far-fetched examples that are not intentional (the manager might have been held captive in the clubhouse and therefore unable to make a lineup change), but intentional decisions seem the place to start.

- **Psychodynamic Explanations:**

  1. **Personal Traits:** Perhaps the manager has always been an extremely conservative person, and is just too scared to use his bench, saving them for possible extra-inning action.
  2. **Emotional States:** Perhaps the manager is very nervous and simply forgot to make the proper move. Or, perhaps he is angry at the pinch-hitter and doesn't want to let him play.
  3. **Subconscious Forces:** Perhaps the manager is subconsciously reminded of the traumatic time he was taken out of a crucial little-league game, and resists taking the pitcher out for that reason.

- **Rational Reasons:**
  - **Prediction of Effects:**
    1. **Actor anticipates weaker bad effects:** The manager may have statistics that show that, against this particular visiting team, the pitcher he is sending up to bat has almost as good an average as the pinch-hitter he's leaving on the bench. Therefore not much is lost by sending the pitcher up. In this case, the actor knows information that the understander doesn't, causing the understander to overestimate the bad effects. Conversely, the manager may not be thinking about what a horrible bunter his pitcher is, causing him to underestimate the bad effects.
    2. **Actor anticipates stronger good effects:** The manager may know that his pitcher is much better against these visitors than anyone else on his staff. Therefore the good effect of keeping his pitcher in the game is greater than the understander realized. Conversely, the manager might not be taking into account the fact that a member of his bull-pen is particularly effective against the men scheduled to come up in the final inning, causing him to overestimate the bad effects of yanking the current pitcher.
  - **Desirability of effects:**

    The manager may know the same facts as the understander but he may just place a higher premium on some of them. He may care more about having the strongest possible pitching because he is worried that even if his team got an extra run, the other team's offense is so explosive against mediocre pitching that they are likely to come back. He may care less about giving the pinch-hitter experience at the plate or care more about building the pitcher's bunting ability than about slightly improving his chances of winning this particular game.

7 Conclusion

The previous sections outlined a categorization of explanations. We have divided things to explain into three broad classes– intentional, social and material anomalies– and have presented the main types of explanations that apply to each of these classes. This classification scheme accounts for a wide range of explanations gathered at the Yale AI lab.

These classes of explanations will provide a criterion for judging how well AI systems explain: they help us determine which types of explanations our systems can handle, and which they cannot. They provide data for devising a representation of explanations, since they show the sort of information that a representation must capture. From the point of view of our work on memory-based explanation, the categorization is also important as a source of indices for retrieving explanations: when an explainer can identify the type of explanation it seeks for a given anomaly, the explanation type should serve as an index to constrain the search for candidate explanations in memory.

We view the categorization of explanations as a necessary first step towards construction of any theory of real-world explanation. We hope that we and other researchers will find it useful as a starting point for further investigation of the fundamental questions underlying explanation. The central role that explanation plays in many AI systems makes understanding of explanation not only a theoretical concern, but also a practical need.

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A The types of explanations

The following appendix elaborates on the diagram in figure 1, incorporating the subcategories of explanations developed in the body of the paper. This provides a complete summary of the types of explanations in our categorization.

Intentional explanations

- Psychodynamic explanations
  - Personal traits
    - Shyness
    - Psychological addictions
    - . . .
  - Emotional states
    - Nervousness
    - Anger
    - . . .
  - Subconscious forces
    - Repression
    - Sublimation
    - . . .
- Rational explanations
  - Predictions of effects
    - Actor anticipates weaker bad effects
      - Actor wrong
        - Outdated information
        - Information from inaccurate source
          - Source misinformed
          - Source deliberately gave false information
        - Ignored information
      - Explainer wrong
        - (Same reasons as for *Actor wrong.*)

Actor anticipates stronger good effects

Actor wrong

(Same reasons as for *Actor wrong* above.)

Explainer wrong

(Same reasons as for *Actor wrong.*)

Desirability of effects

Actor cares more about positive effects than understander

Goal acquisition

Group patterns

Background

Examples/role models

Upbringing

Social values

Goal re-ordering

Devaluation of things you have, and desire for what you don't

Resignation to blockage of higher-level goals

Devaluation of long-term goals in favor of short-term ones

Actor cares less about negative effects than understander

(Same reasons as for *Actor cares more about positive effects.*)

Material explanations

Reasons for unexpected event

Biological laws

Physical laws

Reasons expectations failed

Device failure

Lack of precautions

Execution failure

Missed deadline

Lack of resource

Social explanations

Cultural factors

Social causation

B The Yale Explanation Corpus

The point of this paper has been that something can be learned by taking a hard look at explanations. A temptation when writing about explanation is to work out a theoretical conception without much regard to actual data. We have tried hard not to fall into this trap.

In the summer of 1986 a group of students at the Yale AI lab participated in XP week (XP stands for *explanation pattern*, our knowledge structure for packaging explanations in memory). The task of XP week was to collect as many explanations as possible, and to figure out how to represent them for use by story-understanding programs that members of the lab were developing. The explanations that we collected (which came from the participants and their friends, as well from newspapers and other written sources) proved very useful. They challenged some of the ideas we had been developing about explanation and leant credence to others. The study of these explanations contributed to the formation of the categorization scheme presented in the preceding paper.

This appendix presents the data that was collected during XP week. We have 170 anomalies, with one or more explanations for each, totaling over 350 explanations. (A few additional anomalies and explanations appear in an appendix to [Schank and Riesbeck 85].) There are shortcomings with this data: it was collected by a group of non-naïve subjects who were aware of the relevant theories about explanation, and was not collected in the most naturalistic settings imaginable. There is no guarantee that this set of explanations doesn't leave out some important class of examples; it probably does. We hope that anyone who discovers such problems will add additional installments to this corpus, and thus move the process forward.

Anomaly 1: Why did such an unlikely couple get married?

- **Explanation 1.1:** They were in love.
- **Explanation 1.2:** He wanted her money.
- **Explanation 1.3:** Their folks arranged it.
- **Explanation 1.4:** She was pregnant.

Anomaly 2: Why did he marry out of his faith?

- **Explanation 2.1:** He wanted to hurt his parents.

Anomaly 3: Why did she marry such an old man?

- **Explanation 3.1:** He has lots of money.

Anomaly 4: Why are your in-laws such busybodies?

- **Explanation 4.1:** They are suffering from an empty nest.

Anomaly 5: Why do mothers-in-laws and wives fight?

- **Explanation 5.1:** They both want to control the son/husband.

Anomaly 6: Who don't some men marry?

- **Explanation 6.1:** They can't handle the responsibility
- **Explanation 6.2:** They are moma's boys

Anomaly 7: Why don't some women marry?

- **Explanation 7.1:** They are afraid of husband's brutality

Anomaly 8: Why do some people avoid relationships?

- **Explanation 8.1:** They've had some previous bad experiences

Anomaly 9: Why do couples fight?

- **Explanation 9.1:** They fight over money problems.
- **Explanation 9.2:** It clears the air.

Anomaly 10: Why do men beat their wives?

- **Explanation 10.1:** To show them who's boss.
- **Explanation 10.2:** They are frustrated at work.

Anomaly 11: Why are some people alcoholics?

- **Explanation 11.1:** It's a disease.

Anomaly 12: Why do some people try to make their spouses jealous?

- **Explanation 12.1:** To test their love.

Anomaly 13: Why do couples break up?

- **Explanation 13.1:** One of them isn't satisfied sexually.
- **Explanation 13.2:** One of them is beating the other.
- **Explanation 13.3:** The family of one gives the other a hard time.

Anomaly 14: Why do troubled couples stick together?

- **Explanation 14.1:** They need each other.
- **Explanation 14.2:** For their kids' sake.

Anomaly 15: Why do married people cheat?

- **Explanation 15.1:** They're insecure.
- **Explanation 15.2:** They're not satisfied sexually.
- **Explanation 15.3:** Their spouse is unattractive.

Anomaly 16: Why doesn't that kid look like his father?

- **Explanation 16.1:** His mother cheated on him.

Anomaly 17: Why was the kid so premature?

- **Explanation 17.1:** They were married late.

Anomaly 18: Why do kids get so interested in sex?

- **Explanation 18.1:** It is natural with development.

Anomaly 19: Why are kids today so promiscuous?

- **Explanation 19.1:** The schools teach sex-ed.

Anomaly 20: Why do kids get into sex?

- **Explanation 20.1:** Because of peer pressure.
- **Explanation 20.2:** To prove their love.

Anomaly 21: Why do people think sex education is bad?

- **Explanation 21.1:** It makes kids more active sexually.

Anomaly 22: Why does Sex education make kids more sexually-active?

- **Explanation 22.1:** All the open talk about sex leads the kids to believe that it is being condoned.
- **Explanation 22.2:** It gives them new ideas.

Anomaly 23: Why shouldn't girls have sex?

- **Explanation 23.1:** Boys won't respect them any more.
- **Explanation 23.2:** They might get pregnant.

Anomaly 24: Why do boys want to have sex so much?

- **Explanation 24.1:** They are horny.
- **Explanation 24.2:** They can't get pregnant.

Anomaly 25: Why shouldn't kids have kids.

- **Explanation 25.1:** They still have a lot of learning to do.

Anomaly 26: Why are drugs so popular?

- **Explanation 26.1:** Peer pressure.
- **Explanation 26.2:** You don't have to be responsible for actions.

- **Explanation 26.3:** You can get into more socially acceptable situations.
- **Explanation 26.4:** They are fun.
- **Explanation 26.5:** To relieve depression.
- **Explanation 26.6:** To relieve stress.
- **Explanation 26.7:** People take drugs to copy people they respect.
- **Explanation 26.8:** People start (peer pressure, fun at a party) and then get addicted.

Anomaly 27: Why are more and more teenagers turning to drugs?

- **Explanation 27.1:** Brought up in a bad family, parents take drugs too.
- **Explanation 27.2:** They think this will make their friends like them more. (People will like you more if you're cool.)
- **Explanation 27.3:** They think this will make their friends respect them more.

Anomaly 28: Why does Mexico produce so many drugs?

- **Explanation 28.1:** Mexico is a big drug producer because the government is corrupt.

Anomaly 29: Why do people live badly when they can afford to live better?

- **Explanation 29.1:** People who save most of their money are stingy.

Anomaly 30: Why are people in debt?

- **Explanation 30.1:** People are in debt because they're extravagant.
- **Explanation 30.2:** People are in debt because they're unemployed.
- **Explanation 30.3:** People are in debt when they're putting children through school.

Anomaly 31: Why are people extravagant?

- **Explanation 31.1:** To keep up with the Joneses

Anomaly 32: Why are some people unpopular?

- **Explanation 32.1:** They don't look good (fat, ugly, etc. ...)

Anomaly 33: Why are fat people jolly?

- **Explanation 33.1:** They have to make up for unattractiveness.

Anomaly 34: Why do homely people have such nice personalities?

- **Explanation 34.1:** To make up for unattractiveness.

Anomaly 35: Why are homely people smarter?

- **Explanation 35.1:** Because they study more.

Anomaly 36: Why do people lie about their ages?

- **Explanation 36.1:** Younger is more attractive.

Anomaly 37: Why do some siblings hate each other?

- **Explanation 37.1:** They are frequently compared.

Anomaly 38: Why are some kids spoiled?

- **Explanation 38.1:** They're given everything they want.

Anomaly 39: Why are some kids responsible?

- **Explanation 39.1:** Their parents treat them with respect.

Anomaly 40: Why do some kids rebel against their parents?

- **Explanation 40.1:** It's just natural.

Anomaly 41: Why do some old folks act immature?

- **Explanation 41.1:** They never really grew up.

Anomaly 42: Why are some old folks so sexually aggressive?

- **Explanation 42.1:** They need to reassure themselves.

Anomaly 43: Why do they eat such spicy food?

- **Explanation 43.1:** It's a hot climate and it makes them sweat.
- **Explanation 43.2:** They are poor and it kills their appetite.

Anomaly 44: Why did she leave school?

- **Explanation 44.1:** She was kicked out.
- **Explanation 44.2:** She got an inheritance.
- **Explanation 44.3:** She got pregnant.
- **Explanation 44.4:** There was a death in the family.

Anomaly 45: Why did they move?

- **Explanation 45.1:** The rent was raised.
- **Explanation 45.2:** He got a new job.
- **Explanation 45.3:** He lost his job.
- **Explanation 45.4:** He got a promotion.
- **Explanation 45.5:** They had a kid.
- **Explanation 45.6:** There was a death in the family.

Anomaly 46: Why did he lose his job?

- **Explanation 46.1:** He was incompetent.
- **Explanation 46.2:** There was a drop in business.
- **Explanation 46.3:** The company automated.
- **Explanation 46.4:** He was a threat to his boss.

Anomaly 47: Why is the store closed?

- **Explanation 47.1:** It's a holiday.
- **Explanation 47.2:** You're there during the wrong hours.
- **Explanation 47.3:** They're taking inventory.
- **Explanation 47.4:** They are renovating.
- **Explanation 47.5:** They are moving.
- **Explanation 47.6:** They are on strike.
- **Explanation 47.7:** They're going out of business.

Anomaly 48: Why are they on strike?

- **Explanation 48.1:** Low wages.
- **Explanation 48.2:** Long hours.
- **Explanation 48.3:** Poor conditions.
- **Explanation 48.4:** Sympathy for another group.

Anomaly 49: Why did they go out of business?

- **Explanation 49.1:** Because of the competition.
- **Explanation 49.2:** They went bankrupt.
- **Explanation 49.3:** The owner retired.

Anomaly 50: Why are they running a sale?

- **Explanation 50.1:** They have an overstock.
- **Explanation 50.2:** They're going to take inventory.
- **Explanation 50.3:** They're going to move.

- **Explanation 50.4:** They had a fire.
- **Explanation 50.5:** They need more business.
- **Explanation 50.6:** They're going out of business.
- **Explanation 50.7:** They always run sales.

Anomaly 51: Why's the meat on sale?

- **Explanation 51.1:** Meat is on sale because it's about to spoil.

Anomaly 52: What has the price gone up?

- **Explanation 52.1:** There are higher tariffs.
- **Explanation 52.2:** Exchange rates have fluctuated.
- **Explanation 52.3:** Inflation.
- **Explanation 52.4:** Crop failure.
- **Explanation 52.5:** They're passing on increased labor costs.
- **Explanation 52.6:** They cut back production because of labor union problems.
- **Explanation 52.7:** The government regulations stifled them.
- **Explanation 52.8:** It's just inflation.
- **Explanation 52.9:** They go up and down and we're just seeing them at their high point.
- **Explanation 52.10:** Materials are being used up and companies can't afford 'em any more.

Anomaly 53: Why has the price dropped?

- **Explanation 53.1:** It's the end of season.
- **Explanation 53.2:** A better item has come to the market.
- **Explanation 53.3:** It's a come-on.

Anomaly 54: Why does it cost so much?

- **Explanation 54.1:** It is of higher quality.
- **Explanation 54.2:** For snob appeal.
- **Explanation 54.3:** Because it lasts longer.
- **Explanation 54.4:** Because it looks better.

Anomaly 55: Why do prices of new electronic products drop so drastically in the first year or two, even though the materials and labor costs presumably don't (and may even have gone up)?

- **Explanation 55.1:** Because you're paying for the novelty, not the materials.

Anomaly 56: Why do people buy expensive products when equivalent cheaper ones are available?

- **Explanation 56.1:** People think that more expensive products are necessarily better.
- **Explanation 56.2:** People don't know about the cheaper ones.
- **Explanation 56.3:** People want to display their expensive products as status symbols.
- **Explanation 56.4:** Expensive products usually have better advertisements, which people fall for.
- **Explanation 56.5:** Expensive products usually have better packaging, which people fall for.
- **Explanation 56.6:** Because they want everyone else not to be able to afford them so that they can remain status symbols.

Anomaly 57: Why's product X more expensive than Y.

- **Explanation 57.1:** If the price of X is higher than the price of Y, it's because X is better than Y.

Anomaly 58: Why's product X better than Y?

- **Explanation 58.1:** A well-known product is better than a less-known one.

Anomaly 59: How did he get so rich?

- **Explanation 59.1:** From hard work.
- **Explanation 59.2:** By stepping on other people.
- **Explanation 59.3:** By being a crook.
- **Explanation 59.4:** By being God's chosen.

Anomaly 60: Why are baseball pitchers lousy hitters?

- **Explanation 60.1:** X is a lousy hitter because X is a pitcher and they only play every four days and thats not often enough to get good.
- **Explanation 60.2:** X is a lousy hitter because X he works on pitching instead of hitting.
- **Explanation 60.3:** Pitchers are lousy hitters because if they could hit they'd be outfielders.
- **Explanation 60.4:** Pitchers are lousy hitters because the arm development you do for pitching is no good for hitting.
- **Explanation 60.5:** Why do players hit better with men on base?
- **Explanation 60.6:** X gets hit with man on first because the firstbaseman is covering first, so there's a large hole in the infield.
- **Explanation 60.7:** X hits better with man on first because the pitcher is distracted by the runners (worried about steals).
- **Explanation 60.8:** X hits better with man on first because the pitcher cannot wind up.
- **Explanation 60.9:** X hits better with man on first because the pitcher cannot afford to pitch around him.
- **Explanation 60.10:** X hits better with men on first because he is more motivated to hit well.
- **Explanation 60.11:** X hits better with man on first because first-baseman is screened by runner.

- **Explanation 60.12:** X hits better with man on first because pitchers pitch selection is restricted.

Anomaly 61: Why do pitchers throw at batters?

- **Explanation 61.1:** Pitchers throw at batters because they want to keep them from crowding the plate.
- **Explanation 61.2:** Pitchers throw at batters because they want to intimidate or distract them.
- **Explanation 61.3:** Pitchers throw at batters in retaliation.
- **Explanation 61.4:** Pitchers throw at batters accidentally.
- **Explanation 61.5:** Pitchers throw because they actually want to injure them.

Anomaly 62: Why do most teams play better at home?

- **Explanation 62.1:** The home crowd pumps them up.
- **Explanation 62.2:** The dimensions of the park are optimized for them.
- **Explanation 62.3:** The turf is optimized for them.
- **Explanation 62.4:** Practice effect (like taking tests somewhere you're used to).
- **Explanation 62.5:** They get more sleep living at home.

Anomaly 63: Why does George Steinbrenner keep hiring and firing Billy Martin?

- **Explanation 63.1:** The situation is volatile. He hires him and fires him as his needs change.
- **Explanation 63.2:** He's a moron and can't remember more than 3 weeks back.
- **Explanation 63.3:** He's ambivalent about him. Likes him on the field but can't deal with off-the-field behavior.

Anomaly 64: Why do pitchers give intentional walks?

- **Explanation 64.1:** To fill up empty bases to create the force play.
- **Explanation 64.2:** To keep dangerous hitters from getting big hits.

Anomaly 65: Why do sometimes play back with a man on third and one out?

- **Explanation 65.1:** An out is more important than a run if you're ahead by a lot.

Anomaly 66: Why do infields always play back with a man on third and two out?

- **Explanation 66.1:** Because if they can get an out the run won't count and its easier to get the out at first with the infield back.

Anomaly 67: Why do some batters hit worse with a man on first?

- **Explanation 67.1:** They choke.

Anomaly 68: Why do batters with sluggers behind them hit for higher averages?

- **Explanation 68.1:** Because the pitcher is wants to avoid walking them.
- **Explanation 68.2:** Because the pitcher is nervous.

Anomaly 69: Why don't batters sac bunt with man on second one out?

- **Explanation 69.1:** Because it takes a single to get someone home in any case, and so you're just wasting an out.

Anomaly 70: Why does the American league usually win the World Series while the National usually wins the all-star game?

- **Explanation 70.1:** Talent more concentrated in American.
- **Explanation 70.2:** Team organization and comraderie stronger in American.

Anomaly 71: Why do baseball players do so much coke?

- **Explanation 71.1:** They don't do that much, you just hear about it more.
- **Explanation 71.2:** They're young and successful too fast (Janis Joplin effect).
- **Explanation 71.3:** Their lives are too much of a grind.
- **Explanation 71.4:** All rich people do lots of coke.

Anomaly 72: Why is that person crying?

- **Explanation 72.1:** They are in pain.
- **Explanation 72.2:** They are sad.
- **Explanation 72.3:** They are happy.
- **Explanation 72.4:** They have been chopping onions.

Anomaly 73: Why is there water on the floor?

- **Explanation 73.1:** It was just washed.
- **Explanation 73.2:** Something spilled.
- **Explanation 73.3:** Something leaked.

Anomaly 74: Why doesn't the phone work?

- **Explanation 74.1:** I forgot to pay the bill.
- **Explanation 74.2:** A wire is disconnected.

Anomaly 75: Why doesn't the TV work?

- **Explanation 75.1:** Its old and worn out.
- **Explanation 75.2:** Someone's using an electric razor.
- **Explanation 75.3:** It needs a new tube.

Anomaly 76: Why is there so much crime?

- **Explanation 76.1:** Jails are so crowded they can't convict too many people. People get to know this and know they can commit crimes and only get parole.
- **Explanation 76.2:** People are getting less virtuous.
- **Explanation 76.3:** A segment of society has values that are changing.
- **Explanation 76.4:** Police are using really complicated machinery and they are getting faked out by clever kids.

- **Explanation 76.5:** Greater security measures make committing the crime more attractive.

- **Explanation 76.6:** Because contempt of society and its rules is trendy, and so kids grow up thinking that some types of crimes are actually acceptable.

- **Explanation 76.7:** Because movies portraying the hero as a tough guy (like Rambo) are a bad influence on kids.

- **Explanation 76.8:** Because Rambo dolls and other war toys are a bad influence on kids and make them more militant.

Anomaly 77: Why do rich people shoplift?

- **Explanation 77.1:** Because everyone wants to get things for free even if they can easily afford to pay for them.

- **Explanation 77.2:** Because they are compulsive shoplifters (kleptomaniacs) for the thrill of it.

Anomaly 78: Why are there so many different products?

- **Explanation 78.1:** They make superficial changes to make you think it's something new and will hence do a better job.

- **Explanation 78.2:** Advertising has become a big business because of the video boom and so they can support more products.

- **Explanation 78.3:** People want more variety than they used to.

- **Explanation 78.4:** They want to corner a new piece of the market while retaining their old piece (the *Classic Coke* explanation).

- **Explanation 78.5:** Companies like to reintroduce old products as new ones to make money because they are lazy.

- **Explanation 78.6:** They are just giving the people what they want.

- **Explanation 78.7:** They don't know what the public really wants.

Anomaly 79: Why will people buy products that are rip-offs?

- **Explanation 79.1:** The population doesn't know what they really like so they can be convinced about anything.

- **Explanation 79.2:** people can be easily convinced of an alternative when they are undecided.

- **Explanation 79.3:** The new generation wants stuff that is different than what their parents had.

- **Explanation 79.4:** People are impressed by fancy containers: they only look "skin deep."

- **Explanation 79.5:** People only think about the short-term.

- **Explanation 79.6:** When something changes quickly, people want something that will work for the present instead of something that will work through all of the variability.

Anomaly 80: Why does this package contain so much air?

- **Explanation 80.1:** No motive of manufacturer: natural settling.

- **Explanation 80.2:** Sales strategy: people will buy bigger packages with same price.

- **Explanation 80.3:** There's a good reason for puffing up packages ("pillow packaging" — less damage to product).

Anomaly 81: Why do people buy this artificial product?

- **Explanation 81.1:** People don't know it's artificial.

- **Explanation 81.2:** People think the good effects are more important than the bad (e.g., diet soft drinks).

Anomaly 82: Why do people only buy natural + vegetarian products?

- **Explanation 82.1:** New puritanism natural style: people believe it's better to eat something that is natural even if it is flavorless and costs more because killing is evil and the natural way is the only way.

- **Explanation 82.2:** Vegetarian squeamishness people are vegetarians because they don't like the idea about animals being killed. there are no moral principles.

Anomaly 83: Why did he screw up at *go*?

- **Explanation 83.1:** He's overconfident and thus fails to think about tactics enough.

- **Explanation 83.2:** He's overconfident and thus chooses unrealistically ambitious goals.

- **Explanation 83.3:** He's inexperienced and thus chooses a poor analogical map between real-world aggression and aggressive play in *go*.

- **Explanation 83.4:** He's inexperienced and thus fails to have a multi-layered strategy.

- **Explanation 83.5:** He's inexperienced and thus lacks ability to reason tactically.

- **Explanation 83.6:** He keeps on pursuing plans even when their goals are no longer achievable.

Anomaly 84: Why's he missing the obvious?

- **Explanation 84.1:** He's so caught up in details that he misses the big picture.

Anomaly 85: Why was he beaten up?

- **Explanation 85.1:** Someone wanted to get revenge.

Anomaly 86: Why was X mugged?

- **Explanation 86.1:** People are mugged because they look vulnerable.

- **Explanation 86.2:** People are mugged because they display their valuables.

- **Explanation 86.3:** People are mugged because they go into dangerous areas.

Anomaly 87: Why did the child die?

- **Explanation 87.1:** Playing in the traffic causes being run over.

Anomaly 88: Why'd the plant die so soon?

- **Explanation 88.1:** Plant dies because you don't water it enough.

- **Explanation 88.2:** Plant dies because it doesn't get enough sun.

Anomaly 89: Why'd the patient die?

- **Explanation 89.1:** Patient died because the doctor botched surgery.

Anomaly 90: Why do fat people tend to die young?

- **Explanation 90.1:** People who eat a lot gobble and choke (Mama Cass)
- **Explanation 90.2:** Fat people are more prone to heart attacks.

Anomaly 91: Why'd he have a heart attack?

- **Explanation 91.1:** Heart attacks are caused by stress.

Anomaly 92: Why would someone harm a spouse?

- **Explanation 92.1:** Revenge for an affair

Anomaly 93: Why was X shot?

- **Explanation 93.1:** Shooting because of an argument.

Anomaly 94: Why was X killed?

- **Explanation 94.1:** Killed by spouse's lover.
- **Explanation 94.2:** Killed for the life insurance money.
- **Explanation 94.3:** Killed by business partner for control of business.
- **Explanation 94.4:** Killed for inheritance.
- **Explanation 94.5:** Killed to punish nonpayment of debt.
- **Explanation 94.6:** Killed for revenge – infidelity.
- **Explanation 94.7:** Killed for racial motives.
- **Explanation 94.8:** Killed to silence him as a witness to a crime.
- **Explanation 94.9:** Killed during robbery (or in a faked robbery, to cover a hit).
- **Explanation 94.10:** Killed for political views.
- **Explanation 94.11:** Killed to validate threat against a group of which he's a member, or to frighten someone connected with him.

- **Explanation 94.12:** Killed during fight.
- **Explanation 94.13:** Killed by rapist.
- **Explanation 94.14:** Mafia hit.

Anomaly 95: Why'd he get pimples?

- **Explanation 95.1:** Pimples are caused by eating chocolate.

Anomaly 96: Why'd he get pneumonia?

- **Explanation 96.1:** Pneumonia is caused by getting too cold.

Anomaly 97: Why's he sneezing so much?

- **Explanation 97.1:** Someone sneezes a lot because of having a cold.
- **Explanation 97.2:** Someone sneezes a lot because of having hay fever.

Anomaly 98: Why didn't the government do something to respond to problem?

- **Explanation 98.1:** Government fails to take proper action because of internal dispute.

Anomaly 99: Why'd someone who didn't work very hard get promoted?

- **Explanation 99.1:** Employee is promoted because he has good connections.

Anomaly 100: Why was employee fired?

- **Explanation 100.1:** Employee is fired because boss doesn't like him.

Anomaly 101: Why was employee layed off?

- **Explanation 101.1:** Employee is layed off because employer is in trouble and cutting payroll.

Anomaly 102: Why didn't the child come home as usual?

- **Explanation 102.1:** A child disappears because he's abducted.

Anomaly 103: Why's someone unusually helpful?

- **Explanation 103.1:** Someone's unusually helpful because he's embarrassed about something he did.

Anomaly 104: Why's someone helpful when it's out of character?

- **Explanation 104.1:** Someone's unusually helpful because he wants a favor.

Anomaly 105: Why'd the dish burn?

- **Explanation 105.1:** Something on the stove burns because the heat's too high.

Anomaly 106: Why doesn't the milk taste right?

- **Explanation 106.1:** Milk is sour because it's been kept too long.
- **Explanation 106.2:** Milk is sour because it was left unrefrigerated.
- **Explanation 106.3:** Milk tastes different because foreign countries ultra-pasturize it.
- **Explanation 106.4:** Milk tastes different because foreign countries don't remove the things the U.S. does when they process it.

Anomaly 107: Why doesn't my Apollo work?

- **Explanation 107.1:** An Apollo doesn't work because it's too hot.

Anomaly 108: Why isn't my car where I left it?

- **Explanation 108.1:** Your car is gone because it was towed.
- **Explanation 108.2:** You car's gone because it was stolen.

Anomaly 109: Why didn't the car start when I turned the key?

- **Explanation 109.1:** A car doesn't start because it's too cold outside.

Anomaly 110: Why's the car repair so expensive?

- **Explanation 110.1:** Price of a repair is too high because the repairman's taking advantage of you.
- **Explanation 110.2:** Repairs of foreign cars are always expensive.

- **Explanation 110.3:** Repairs of luxury cars are always expensive.

Anomaly 111: Why's driver late?

- **Explanation 111.1:** Driver is late because of heavy traffic.

Anomaly 112: Why'd the driver swerve?

- **Explanation 112.1:** A driver swerves to avoid an animal.

Anomaly 113: Why's traffic so heavy?

- **Explanation 113.1:** Traffic is bad because of construction on the roads.

Anomaly 114: Why's traffic backed up?

- **Explanation 114.1:** Traffic is backed up on the highway because of an accident.

Anomaly 115: Why's traffic slow?

- **Explanation 115.1:** Traffic is slow on the highway because police are checking speed.

Anomaly 116: Why was his license suspended?

- **Explanation 116.1:** If someone's license is suspended, it's probably because of drunk driving.

Anomaly 117: Why do teenagers have so many car accidents?

- **Explanation 117.1:** Teenagers have car accidents because they're reckless.

Anomaly 118: Why didn't the government do something to respond to problem?

- **Explanation 118.1:** Government fails to take proper action because of internal dispute.

Anomaly 119: Why would a politician retire at the height of his career?

- **Explanation 119.1:** Politician retired because misdeeds were about to be exposed.

Anomaly 120: Why would an incompetent candidate be elected?

- **Explanation 120.1:** Candidate elected because he's famous.

Anomaly 121: Why didn't the favorite win the election?

- **Explanation 121.1:** A candidate loses because he got overconfident.

Anomaly 122: Why'd the underdog lose the election?

- **Explanation 122.1:** A candidate loses because he has a small organization.

Anomaly 123: Why would people have tolerated the regimented lifestyle of Jonestown?

- **Explanation 123.1:** People join fanatical religious groups because they want someone to control their lives.

Anomaly 124: What goals does a terrorist attack serve?

- **Explanation 124.1:** Terrorists attack in order to get publicity.

Anomaly 125: Why does France have a low alcoholism rate?

- **Explanation 125.1:** France has a low alcoholism rate because alcohol isn't regulated as something special.

Anomaly 126: Why does France have a high alcoholism rate?

- **Explanation 126.1:** France has a high alcoholism rate because alcohol's so easily available.

Anomaly 127: Why does the government waste money?

- **Explanation 127.1:** Government wastes money because officials think you can solve problems by throwing money at them.

Anomaly 128: Why's the product so cheap?

- **Explanation 128.1:** If something's very cheap, it's probably because it's a local product.

- **Explanation 128.2:** If something's very cheap, it's probably because it's made in large quantities.

Anomaly 129: Why'd he die violently?

- **Explanation 129.1:** He who lives by the sword dies by the sword.

Anomaly 130: Why's the plane late?

- **Explanation 130.1:** Plane is delayed because of heavy air traffic.
- **Explanation 130.2:** Plane is delayed because of mechanical problems.

Anomaly 131: Why is the traveller late?

- **Explanation 131.1:** Traveller arrives late because he got lost on the way.

Anomaly 132: Why's the airport closed?

- **Explanation 132.1:** Airport is closed because of snow.

Anomaly 133: Why'd the underdog athlete win?

- **Explanation 133.1:** An athlete won because he had a grudge against his competitor.

Anomaly 134: Why'd the underdog team win?

- **Explanation 134.1:** A team won because it had the home-court advantage.
- **Explanation 134.2:** Team wins by playing hard out of personal loyalty (winning one for the Gipper)

Anomaly 135: Why was everyone unsatisfied with him?

- **Explanation 135.1:** If you try to sit on two stools, you fall between.

Anomaly 136: Why do rich communities have good schools?

- **Explanation 136.1:** Rich communities can afford to spend a lot on education, so they have good schools.

Anomaly 137: Why are private school students better than public ones?

- **Explanation 137.1:** Private school students have successful parents who are a good example.

Anomaly 138: Why didn't a student turn in the assignment?

- **Explanation 138.1:** Student doesn't turn in assignment because he's lazy.

- **Explanation 138.2:** Student doesn't turn in assignment because he thinks he can get away with being late.

Anomaly 139: Why do I have to wait so long for this?

- **Explanation 139.1:** A watched pot never boils.

Anomaly 140: Why does this company give better service than its competitor?

- **Explanation 140.1:** Number 2 tries harder than number 1.

Anomaly 141: Why's Johnny so obnoxious?

- **Explanation 141.1:** Children misbehave in order to get attention

Anomaly 142: Why are prices so high for military equipment?

- **Explanation 142.1:** Military equipment costs too much because of lack of competition.

Anomaly 143: Why are american car manufacturers in trouble?

- **Explanation 143.1:** American car manufacturers are in trouble because of low quality products.

- **Explanation 143.2:** American manufacturers are in trouble because of high labor costs.

- **Explanation 143.3:** American manufacturers are in trouble because of unfair foreign competition.

- **Explanation 143.4:** American manufacturers are in trouble because of outdated technology.

Anomaly 144: Why'd he betray our trust?

- **Explanation 144.1:** Never trust a fox to guard the chickens.

Anomaly 145: Why's this meal worse than the last one we had here?

- **Explanation 145.1:** Restaurants always deteriorate soon after they open.

Anomaly 146: Why's the line for tables shorter than usual?

- **Explanation 146.1:** Wooster Square pizza places are less crowded when Yale students are away.

Anomaly 147: Why'd you get a bad table in restaurant?

- **Explanation 147.1:** You get a bad table in a restaurant because waiter doesn't like how you're dressed.

- **Explanation 147.2:** You get a bad table because you didn't reserve.

Anomaly 148: Why'd the waiter treat us badly?

- **Explanation 148.1:** Waiters treat you badly because they think you won't tip

Anomaly 149: Why'd the waiter push one particular dish?

- **Explanation 149.1:** A waiter suggests something because the restaurant has too much of it.

- **Explanation 149.2:** A waiter suggests something because it's especially good.

Anomaly 150: Why's there a drop in tourism this summer?

- **Explanation 150.1:** Americans are staying away from Europe because of fear of terrorism.

Anomaly 151: Why are insurance rates skyrocketing?

- **Explanation 151.1:** Insurance rates are skyrocketing because of the litigation crisis.

Anomaly 152: Why'd the landlord finally fix up my apartment?

- **Explanation 152.1:** The landlord fixed up the apartment as an excuse to charge you more rent.

Anomaly 153: Why do terrorists claim responsibility for the attacks rather than trying to remain anonymous (which is what most criminals would do)?

- **Explanation 153.1:** Because they want to promote their cause.

- **Explanation 153.2:** Religious fanatics do terrorisms to spread their religion (possibly at the expense of other goals).

Anomaly 154: Why do poorer people have more kids (when they are the ones who can afford them the least)?

- **Explanation 154.1:** "Two hands, one mouth" philosophy. More kids to work leads to more income for the family.

- **Explanation 154.2:** They are less educated about family planning.

Anomaly 155: Why do people prefer to have boys?

- **Explanation 155.1:** Because boys carry on the family name.

- **Explanation 155.2:** Because boys work and bring in income.

- **Explanation 155.3:** Because girls have to be married off and eventually go away.

- **Explanation 155.4:** Because girls have to be married off which costs a lot in dowry.

Anomaly 156: Why are more couples having only one kid even though most start out wanting two or three, and there's danger of only children growing up lonely or spoilt?

- **Explanation 156.1:** Because they have less time to take care of them since both work.

- **Explanation 156.2:** Because it is too expensive to have kids.

- **Explanation 156.3:** Because couples marry later in life nowadays, and so they are too old by the time they're ready to have their second kid.

Anomaly 157: Why should we expect people to want to have more than one kid?

- **Explanation 157.1:** An only child will be lonely.

- **Explanation 157.2:** An only child will grow up spoilt.

Anomaly 158: Twins grow up without any individuality because their parents keep making them more like each other (dress them up similarly, etc.).

- **Explanation 158.1:** Why do parents do this even though they know this?

Anomaly 159: Why is life cheap in poor countries?

- **Explanation 159.1:** Because they are crowded.
- **Explanation 159.2:** Because many people die and so people get more used to death.

Anomaly 160: Why are is there a sudden outburst of rock stars from the 60's going on concert tours this year? (Eric Burden/The Animals, The Guess Who, Chuck Berry, The Temptations, ...).

- **Explanation 160.1:** Maybe a lot of the groups have the same manager.
- **Explanation 160.2:** Maybe nostalgia is becomeing much stronger.

Anomaly 161: Why did X die in his prime?

- **Explanation 161.1:** He did a risky action for the thrill of it. Unfortunately for him, he died.
- **Explanation 161.2:** Once he started taking drugs he lost control and couldn't stop at the point where he had intended to.
- **Explanation 161.3:** He committed suicide.
- **Explanation 161.4:** He was too big a risk taker.
- **Explanation 161.5:** he took drugs to relieve a stressful life and overdosed.
- **Explanation 161.6:** he was hooked on a killing substance and it eventually got to him (cigarettes, booze, drugs).

Anomaly 162: Why did X commit suicide?

- **Explanation 162.1:** X worked too hard. He got depressed with his way of life and committed suicide.
- **Explanation 162.2:** X loved Y. When Y spurned X, he committed suicide.
- **Explanation 162.3:** X was a teenager who was perpetually fighting with his parents to get his way. He finally got very depressed and committed suicide.
- **Explanation 162.4:** X failed his exams. Too ashamed to tell his parents, he killed himself.

- **Explanation 162.5:** X lived a stressful life. He took drugs to relieve the stress and accidently took an overdose.

- **Explanation 162.6:** X lived a stressful life. The pressure of his life finally took its toll and he had a heart attack.

- **Explanation 162.7:** X's husband divorced her. Being a conventional Japanese woman, she took her own life.

- **Explanation 162.8:** X's husband died. X committed sati.

- **Explanation 162.9:** X was crazy.

- **Explanation 162.10:** Depression leads to suicide.

Anomaly 163: Why are there more suicides in households which keep a gun at home for self-defense that in those without?

- **Explanation 163.1:** It is easier to get at a suicide instrument in a fit of depression.

- **Explanation 163.2:** If you didn't have the gun, you might get over your fit by the time you organized an instrument.

- **Explanation 163.3:** Having guns around you makes you feel suicidal.

- **Explanation 163.4:** Having guns around you and thinking about using them on burglars makes you think about violence, increasing your proclivity to violent thoughts during fits of depression.

- **Explanation 163.5:** Guns are more effective than, say, pills, so even though there aren't really more people wanting to commit suicide in households with guns, more suicide attempts succeed if they use guns.

Anomaly 164: Why did he accept a suicide mission?

- **Explanation 164.1:** He was willing to sacrifice his life for the sake of his country. (E.g., on a Kamikaze mission)

- **Explanation 164.2:** He was willing to sacrifice his life for his religion. (E.g., on a suicide mission against the Israelis)

Anomaly 165: Why did he kill himself with a hunger strike?

- **Explanation 165.1:** X was willing to sacrifice his life for the IRA cause.

Anomaly 166: Why is he depressed?

- **Explanation 166.1:** Tension leads to depression.
- **Explanation 166.2:** Boring lives (vegetation) lead to depression.
- **Explanation 166.3:** Bad family life causes the kids to get depressed.
- **Explanation 166.4:** Getting poor school grades causes depression in a kid.

Anomaly 167: Why do people start smoking?

- **Explanation 167.1:** Boredom.
- **Explanation 167.2:** Being in the army makes you start smoking.

Anomaly 168: Why do older people tend to be more conservative than younger ones? Why do people get more conservative as they get older?

- **Explanation 168.1:** More scripty, less cre , less flexible.

Anomaly 169: Why do Americans want to get tanned, but Indians want to get fairer?

- **Explanation 169.1:** The grass is always greener on the other side.

Anomaly 170: Why do students drop out? (from *New Haven Register*).

- **Explanation 170.1:** They dislike school.
- **Explanation 170.2:** Learning difficulty, low grades.
- **Explanation 170.3:** Pregnancy, marriage.
- **Explanation 170.4:** Economic need, finding a job.
- **Explanation 170.5:** History of failure in school.
- **Explanation 170.6:** Pushed out; raised standards could not be met.
- **Explanation 170.7:** Burned out; trying too hard to succeed.
- **Explanation 170.8:** Poor relationships with teachers and peers.
- **Explanation 170.9:** Poor home support for education.
- **Explanation 170.10:** Lack of supportive environments.
- **Explanation 170.11:** Language, cultural barriers.

END

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