A Brief History and Critique of Causation

Abstract

The notion of causation has been a major item of discussion throughout time. Unfortunately, each new theory of causation simply regurgitates and revises past philosophies, resulting in a lexicon of fanciful terms with little practical application. Today, our high tech world requires a much clearer and more practical understanding of causation than that provided by the philosophers of yesteryear. This paper discusses the historical perspectives on causal thinking from the earliest sources, the limitations thereof, and the evolution of a Principium of Causation—which allow us, for the first time, to understand and communicate the complex causal relationships common in all human events.

Introduction

Causal thinking is the process of understanding the causes of a given event such that we can control them to our advantage. Since the dawn of human thought, asking why has allowed us to better understand the world around us and thus control real world variables to better meet our needs. However, it has taken tens of thousands of years of human thought for us to develop a theory of causation that consistently defines known events, every time. Today, there are many causal analysis tools that attempt to provide a structured problem-solving method, but only one works every time. There is change analysis, differences analysis, hazards analysis, barrier analysis, failure modes and effects analysis, fault tree analysis, cause trees, and many categorical "root cause analysis" schemes, but none of these provide essential principles of causation,[1] known as a principium that apply to every event, every time. Indeed, the fact that there are so many different approaches further demonstrates the lack of a cause-and-effect principium.

In a time when all that was needed was how to put food on the table and

[1] Gano, Dean L.; *Apollo Root Cause Analysis – A New Way of Thinking*; p. 178; copyright 1999, Third Edition 2007; by Apollonian Publications, LLC.

procreate, humans only had to understand simple causal relationships, such as spear kills dear; dear eaten; hunger satisfied; time for bed. Today however, in a world with increasingly complex economic, social, and environmental problems, the need to clearly understand complex causal relationships may make the difference between the survival and extinction of the human species.[2]

In order to understand why we have failed to develop a principium essential to effective problem solving, understanding the past will help us discover a new way of thinking about causation. Let's see what history can teach us.

Persian, Indian, and Asian Philosophy

Most early philosophies from the 8th to the 3rd century BCE did not concern themselves with causation. Most certainly they asked *why*, but the notion of causation was not recognized as a subject unto itself, rather the specific answers to *why* questions were at the heart of their culture. They were more focused on the notion of morality and a path to successful human culture centered around various forms of religion and cultural rules. Buddhism seems to be the only exception of this era.

Buddhism on Causality

Concurrence of Cause

One of the oldest written discussions of cause and effect can be found in the writings of Buddhism, which began in 589 BCE.[3] Buddhism states that causality is only in our minds; it therefore is not real. However, somewhat contradictory, Buddha goes on to say: "…everything in the world is the result of a vast concurrence of causes and conditions, and everything disappears as these

[2] Perrow, Charles; *Normal Accidents: Living with High Risk Technologies*, p. 304 - 356; Copyright 1999 by Princeton University Press.
[3] Prinyayogavipulya, Luang; *Concise Principles of Buddhism*; 1957 Second Edition

causes and conditions change and pass away."[4]

Critique of Buddha's Concurrence of Causes:

While *concurrence* provides legitimate insight about how effects must have a cause that is later in time, they are viewed as exclusively linear in time (A caused B, B caused C, C caused D, etc.) "…everything being a concordance and succession of causes and conditions…"[5] This linear thinking is still common today in most modern cultures[6] and is a major barrier to effective problem solving because real-world events are non-linear.

Causal Net

We also learn from Buddha's teachings that all causes are connected, "As a net is made up by a series of knots, so everything in the world is connected by a series of knots."[2]

Critique of Buddha's Causal Net

The idea that causes are part of net, possibly represented by the knots is contradictory to causes being sequential as stated earlier. While there was some notion of a large set of interrelated causes, this is where the discussion ends – with no details of the net's structure.

Fallacy of Duality and Categorization

Buddha also believed that the notion of duality, such as right and wrong, good and evil are simplistic constructs based on ignorance. Instead, Buddhism professes that when we categorize, we make incorrect judgments that prevent us

[4] Bukkyo Dendo Kyokai; *The Teaching of Buddha*; p. 41-42, copyright 1966; 202nd revised edition; printed by the Society for the Promotion of Buddhism
[5] Bukkyo Dendo Kyokai; *The Teaching of Buddha*; p. 54, copyright 1966; 202nd revised edition; printed by the Society for the Promotion of Buddhism
[6] *Stanford Encyclopedia of Philosophy*; Causal Processes; Dec. 8, 1996 and updated Sept. 10, 2007

from reaching Enlightenment,[7] which is the ultimate goal of Buddhism.

Critique of Buddha's Take on Duality and Categorization

As early as the 6th century BCE, Buddha understood the failed strategy of categorization as seen in dualism. Unfortunately, Western cultures never got the message as categorization has been used extensively since the early Greeks and is still common today. Fortunately, some modern strategist, such as Ruggiero[8] recognizes the "either/or outlook" as an error of perspective that limits critical thought.

Causality and the Ancient Greeks

Categorization

The ancient Greeks embraced a categorical notion of cause and effect. Aristotle (384 - 322 BCE) proposed four categories of cause.[9]

1. Material cause: found by asking: "Out of what has a thing come?"
2. Formal cause: found by asking: "What is it?"
3. Efficient cause: found by asking: "By what agent did it come" The father is the *efficient cause* of the son.
4. Final cause: found by asking: "For what end or purpose does the thing exist? Alive is a *final cause* of eating.

Critique of Aristotle's Four Causes

These categories ask where and what did something come from, what is it, and what is its purpose, but they fail to ask "why?" By asking why, the

[7] Bukkyo Dendo Kyokai; *The Teaching of Buddha*; p. 53-64, copyright 1966; 202nd revised edition; printed by the Society for the Promotion of Buddhism
[8] Vincent Ryan Ruggiero; *Beyond Feelings - A Guide to Critical Thinking*; p. 96, copyright 2004; seventh edition; printed by McGraw Hill.
[9] Jancar, Barbara; Assistant Professor of Government, Skidmore College; *The Philosophy of Aristotle*; p 55; copyright 1966 by Thor Publications.

answer is always "because" That is to say, there "be a cause" that precedes the item we are asking why of. While this may seem obvious to us, it was not obvious to the great thinkers of ancient Greece. Unfortunately, all notions of causation that follow in history use some kind of prescribed hierarchy of causes.

Saint Thomas Aquinas on Causality

Conditions and Actions

By the 13th century, Saint Thomas Aquinas (1224 – 1274) of Sicily expanded the Aristotelian notion of four causes by adding three principles of nature, namely matter, form, and privation (the act of depriving) – again more categorization. More importantly however, Aquinas noted that: "potency cannot reduce itself to act."[10] That is to say, a condition must be acted upon in order to create an effect. "The copper cannot become a statue by it's own existence," he noted.

Critique of Conditions and Causes

Aquinas understood the need for an action cause and a conditional cause to create an effect, but did not make the connection that both causes must occur at the same time and space. Rather, he supposed that causes are linear, which led to his argument for contingency.

Cosmological Argument.[11]

Simply stated, St. Thomas' argument is that everything is contingent upon something prior to itself; i.e. effect and cause. He supposed that if you keep going back in time there could be a point where nothing exists, but if this were the case, nothing would exist today, so he concluded: "Since there are things in existence, there must be something which is not contingent, and this we call God."[12]

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[10] Vernon J. Bourke; *The Pocket Aquinas*; p 67; copyright 1960 by Washington Square Press.
[11] Hick, John; *Philosophy of Religion*; p 21; Copyright 1964; Prentice–Hall, Inc.
[12] Hick, John; *Philosophy of Religion*; p 22; Copyright 1964; Prentice–Hall, Inc.

Critique of Cosmological Argument

While the term "Root Cause" was not used by philosophers of this time, the notion of an end cause was clearly there. One difficulty with this argument is that it ignores the definition of *infinity*, which is merely a theoretical construct to signify that something can go on forever. While it is impossible for us to comprehend an infinite set of causes, any given problem analysis uncovers a nested subset of the infinite set of causes that is our reality. The limits of the subset are bounded by the problem owner's knowledge or level of comfort that enough causes have been identified to find effective solutions. Attempting to go beyond these limits may satisfy philosophical or spiritual needs, but they do not a principium make.

David Hume on Causality

Cause and Effect as Unique Mental Constructs

David Hume (April 26, 1711 – August 25, 1776) was an 18th-century Scottish philosopher, economist, and historian, considered among the most important figures in the history of Western philosophy and the Scottish Enlightenment. His take on causation holds that our understanding of cause and effect are mental constructs unique to each observer.[13]

Critique of Mental Constructs

Hume's belief that reality is unique to each person was based on Plato's argument in the *Allegory of the Cave,* where prisoners are held in a cave and only know objects from shadows on the wall. Once allowed to leave the cave another reality is learned that is in conflict with the shadow world, so what is real?

Today we know "reality" is caused by the way the brain works. Cognition is caused by a biological mechanism where neurons fire together in the

[13] Vernon J. Bourke; *The Pocket Aquinas*; p 67; copyright 1960 by Washington Square Press.

same pattern each time they are activated. Each time the same neurons fire in synchrony the connection is strengthened.[14] It is not a requirement that neural connections be caused by environmental stimuli. As we can imagine an elephant fly, we can create our own realities simply by thinking about it. While the mind uses complex strategies to create a reality, it is unique to each person. There is nothing magical or mysterious about cognition; it is a repeatable biological process, nothing more. Furthermore, spirituality and mysticism are part of the brain's biology. Located in the temporal lobe is an area that, if electrically stimulated, will cause a spiritual experience in an otherwise non-spiritual person.[15] And like any cognition, the more we stimulate the neurons that are assigned to mysticism, the stronger the connections and the more "real" they become.

The lesson of Plato's cave is that whether it is effective communication or problem solving we must accommodate the relative nature of reality or these endeavors will fail. Categorical schemes that prescribe a set of predefined causal factors are based on the reality of the person who created them and thus produce an illegitimate and dogmatic notion of Reality.

Manipulation Theory

Hume also proposed that understanding cause and effect relationships helps us explain and predict the behavior of objects, and hopefully come to control them. In philosophical circles this is known as the *Manipulation Theory*,[16] where the purpose of explaining causation is to manipulate causes.

Critique of Manipulation Theory

While it may seem self evident, this theory was challenged by ethereal philosophers as unacceptable because they saw it as circular logic or anthropocentric.

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[14] Carter, Rita; *Mapping the Mind*; p. 160; Copyright 1998 by University of California Press.
[15] Carter, Rita; *Mapping the Mind*; p. 13; Copyright 1998 by University of California Press.
[16] Collingwood, R; *An Essay on Metaphysics*; Clarendon Press.

Modern Notions of Causation

Language of Causation Theories

Since Philosophy is by definition the pursuit of knowledge, it is only logical that the notion of causation has always been and continues to be a major item of discussion in philosophical circles. Unfortunately, each new theory of causation has simply regurgitated and revised past philosophies resulting in a lexicon of fanciful terms with little practical application. An example of this useless rhetoric can be found in a philosophical tome on causation, written in 2003 by James Woodward. He states: "The difference between interventionist counterfactuals such as (1.4.7) and noninterventionist counterfactuals such as (1.4.6) corresponds, roughly to the difference between what Lewis (1973-1986) calls nonbacktracking and backtracking counterfactuals.[17]

Critique of Language of Causation

In failing to break out of past paradigms, many modern philosophical thinking continues to categorize and describe the characteristics of causation without providing a principium.[18] For example, Woodward writes of his notion of causation: "The theory (of causation) should be descriptively adequate in the sense that it captures relevant features of paradigmatic explanations in science and ordinary life." "If the theory recognizes different varieties or sorts of causal explanations (as the theory I propose does), it should show us what these have in common: why it is that they all count as species of the genus "causal explanation.""[19]

Naming Causes

Other modern categorical schemes attempt to define cause and effect by assigning a name to causes, such as proximate cause, apparent cause, immediate cause, contributing cause, necessary cause, sufficient cause, and root

[17] James Woodward; *Making Things Happen*; p 15; copyright 2003 Oxford University Press.
[18] *Stanford Encyclopedia of Philosophy*; Causal Processes; Dec. 8, 1996 and updated Sept. 10, 2007.
[19] James Woodward; *Making Things Happen*; p 23; copyright 2003 Oxford University Press.

cause.

Critique of Naming Causes

While these names are valid within their own realm they provide no value for general problem solving or the basis for a causation principle because there is no principle associated with the name that is applicable every time on every event. The fact that a cause is a proximate cause or an apparent cause is the same as saying a square is a rectangle. While true, this "fact" is void of content and thus provides no value to understanding causality – a vacuous truth. If we say a square has four equal sides, we have assigned a unique principle that is always true. Unfortunately, the vacuous cause names listed above are not so defined and are different for each group or person who uses them.

Modern Prescriptive Hierarchy of Cause

Ishikawa Fishbone and other categorization schemes like Cause Tree and Management Oversight and Risk Tree (MORT) use categories like Manpower, Methods, Machines and Environment as the beginning of their categorical scheme. Each of these categories has sub-categories and those have more sub-sub-categories, creating a tree or outline structure of prescribed causes.

Critique of Prescribed Causes

While it is true that causes can be logically and hierarchically categorized, we must ask what value does this provide? Placing causes in buckets does not provide a complete understanding of causal relationships. As stated by Wilson et al.: "The problem buckets are just too large and non-specific."[20] In these categorization schemes, the subject of the event is categorized and then you "drill down" to the root cause. An example of this is if the event was a car wreck and we look at the category of *environment*, and within *environment* we find the causal factor *lack of visibility*. As we look at the prescribed list of causal factors for *lack of visibility* we might find *obstructed view* and so forth until a cause category

[20] Paul F. Wilson, Larry D. Dell, and Gaylord F. Anderson; *Root Cause Analysis – A Tool for Total Quality Management*; p 48; copyright 1993 by Quality Press.

is voted the "root cause." If the actual causes are not listed in the prescribed list, such as *blind in one eye* we are forced to choose an applicable category and thus fail to understand any causal relationships. A secondary purpose of categorizing is to create a statistical database showing how many causes of a particular type have occurred, but since this process identifies a category, not a cause or its relationships to the problem it is a failed strategy.

Limiting the root cause of an event to a prescribed list not only fails to show how conditional causes and action causes interrelate, it prevents the ability of those working on the problem to express their reality. Furthermore, this anthropocentric process of categorizing, results in endless and useless arguing over who has the correct root cause classification.

On Failed Strategies of Causation

Instead of establishing a principium of causality, Western culture has focused on describing, characterizing, categorizing and naming causes.

Why Cause Categorization?

In light of this preponderance of misguided thinking we must ask "why?" With our newfound understanding of the human brain comes the answer to this important question.

Our brains use a pattern recognition storage and retrieval scheme. For the purpose of discussion, these patterns are called "recognition units" (RU). Each RU is a characteristic of an object or idea, such as the red of a stop sign, or the potential danger in height. Each RU is stored in a physical location along with similar RUs. Through the electrical transmission of millions of neural connections and the operation of certain parts of the brain, the whole of an object or idea and its meaning comes together.[21] Our brain is a parallel processor of great magnitude and it appears we are biologically constructed to use taxonomy

[21] Carter, Rita; *Mapping the Mind*; p. 118; Copyright 1998 by University of California Press.

(categorization) to help us understand our world.

Linear Language Causes Linear Thinking

In addition to the failed strategy of categorization our forefathers failed to understand a cause-and-effect principium because of the linear nature of language and the use of storytelling to communicate knowledge. Because we experience life as a series of events in time, our recollection of our experiences (stories) are communicated as a linear narrative. We simply do not have the mental capacity to understand or communicate the reality of our world that is an infinite set of causes branching and interconnecting in many ways. Furthermore, stories start in the past and come forward to the present while cause-and-effect relationships are observed from the present to the past (Effect A was caused by conditional Cause B AND action Cause C.) For sure we are able to understand short and simple causal sets, but try to deal with more than 6 or 7 causes of an event and our brains quickly go into overload, let alone have the ability to communicate what we think we know.

This propensity for linear thinking can also lead to an error in judgment referred to by Ruggerio[22] as the *post hoc fallacy*. Post hoc fallacy is a flawed belief that if we perceive events occurring in sequence they represent a cause-and-effect relationship. For example, if we see the wind blow and then hear thunder, we may conclude the wind caused the thunder.

Finally, A Principium of Causation

In 1993, Gano presented the "Cause and Effect Principle,"[23] which provides a four-part principium that allows us to understand our reality in a simple structured way and leads to a simple intuitive problem-solving process. The four principles of the principium are as follows:

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[22] Vincent Ryan Ruggiero; *Beyond Feelings. A Guide to Critical Thinking*; p. 112, copyright 2004; seventh edition; printed by McGraw Hill.

[23] Gano, Dean L.; *Apollo Root Cause Analysis – A New Way of Thinking*; p. 41-61; copyright 1999, Third Edition 2007; by Apollonian Publications, LLC.

Gano's Principium of Causation

1. Causes and effects are the same thing only seen at a different point in time.

2. Causes and effects are part of an infinite continuum of causes.

3. Each effect has at least two causes in the form of actions and conditions.

4. An effect exists only if its causes exist at the same point in time and space.

The first principle incorporates the lessons from history (Buddha and St. Thomas Aquinas) and our own observations that causes are seen as a sequence in time from event to cause, where what was once an effect, becomes a cause etc. Note: If we use current time as the reference point, which we must do with any event, causality is actually effect and cause, not cause and effect.

The second principle incorporates what we learned from St. Thomas Aquinas cosmological argument that causes are part of an infinite continuum.

While there have been many attempts at understanding the relationship between condition and action causes, such as Buddha's Causal Net, St. Thomas Aquinas' observation that conditions must be acted upon to create an effect, and in more recent writings by Dr. E. Scott Geller; *The Psychology of Safety* (1979), where behavior is seen as the action in a conditional environment, the fact that both have to occur simultaneously was not clearly expressed. The third principle builds upon these ideas but corrects previous oversights, thus allowing us to know the actual structure of causation for the first time.

The fourth principle was derived from an engineering analysis tool know as Fault Tree Analysis (FTA), originally developed by Bell Telephone Laboratories for the Minuteman missile system in the early 1960's.[24] Events and Causal Factors Charting[25] and Probability Risk Analysis (PRA), [26] also use this notion. These

[24] Wikipedia, Fault Tree Analysis, History
[25] [25] Paul F. Wilson, Larry D. Dell, and Gaylord F. Anderson; *Root Cause Analysis – A Tool for Total Quality Management*; p 151-168; copyright 1993 by Quality Press.
[26] Dr. Michael Stamatelatos, et. al. *Probabilistic Risk Assessment Procedures Guide for NASA Managers and Practitioners*, copyright 2002.

methods specify that events occur at the same time and space, but they do not recognize these events as action and condition causes – just events. The fourth principle significantly clarifies this notion by distilling events down to individual action and condition causes.

From Principium to Practicality

With a clear need to overcome the failed strategy of categorization, linear storytelling, and the limitations in our language to express a large set of inter-related causes, new tools were obviously required. Using the cause and effect principium provided above, Gano devised a simple process[27] shown in Figure 1.

While this simple structured process is highly effective, something more was needed to effectively communicate the many causes common to complex causal relationships, so Gano also developed a computer application to aid in this process[28].

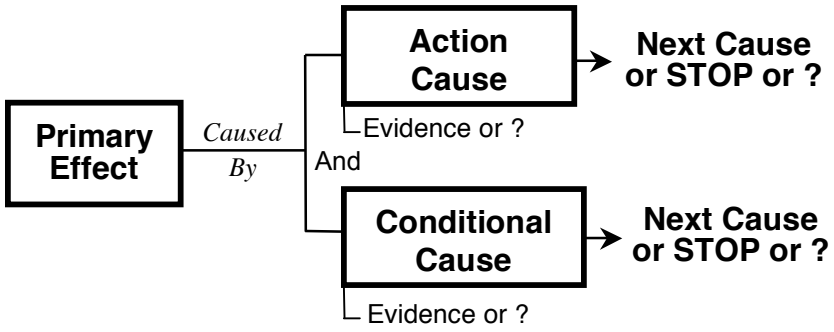

Figure 1. Cause and Effect Process

In this process the Primary Effect is the problem we are trying to prevent from happening again.

By using the words "Caused By" as the conjunction between causes, we are forced to follow time from present to past, which protects us from the linear nature of storytelling that goes from past to present.

Providing the action and conditional causes of each effect and representing them as occurring at the same point in space and time encompasses the third and

[27] Gano, Dean L.; *Apollo Root Cause Analysis – A New Way of Thinking*; p. 63-100; copyright 1999, Third Edition 2007; by Apollonian Publications, LLC.
[28] www.realitycharting.com

fourth element of the cause-and-effect principle. Coupled with the first principle, which has us change a cause into an effect in order to ask *why* again, we create an ever-expanding set of causes (second principle) revealing the potential complexity of a given event.

We continue asking *why* until we don't know, called our point of ignorance, or legitimately choose to stop.

If we do not know the answer, a question mark is inserted to represent our lack of knowledge. Effective problem solving is not about expressing how smart we are, rather it is about asking why until we don't know the answer.

If we know that continuing to ask why will be nonproductive, we may choose to stop, but a reason for stopping must be given.

Providing evidence (also unique to this process) of how you know what you think you know is required to resolve the issue of perception noted by the great philosophers of the past. If we do not have evidence, it does not necessarily mean the cause is invalid, but we need to distinguish it by using a "?" in the evidence box so we know there is a risk associated with including this cause.

It should be noted that since everything is relative to other things and we each have our own schema for these relationships, this process does not force the use of any prescribed categories. Rather, it provides a visual representation of a reality created by each and every person with a stake in the problem. The stakeholders agree upon both evidence and causes, so a common reality is created. With this common reality, solutions are easily agreed upon and assigned to applicable causes. When stakeholders agree which solutions are within their control, prevent recurrence of the problem, and meet their goals and objectives, the group has found the most effective solutions to their problem.

Conclusion

As we can see from this brief stroll through history, the principles of causation were all there, but it wasn't until they were brought together in Gano's Principium of Causation that a consistent problem-solving method for all human events could be developed.