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Blind spots obscuring circular causality in design and elsewhere

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Abstract

Purpose – Circular causality is one of several unorthodox assumptions underlying cybernetics. This paper identifies "blind spots" which obscure the soundness of this assumption, rendering cybernetics liable to rejection. The purpose of this paper is to aid students of cybernetics in appreciating circular causality.

Design/methodology/approach – The presented argument is based on textual and diagrammatic explication of several more or less obvious causal scenarios. Some of these modes are shown to obscure circular causality from observation.

Findings – Previously discussed "blind spots" obscuring circular causality are referenced. The notion of probabilistic causality is developed from the notion of collateral effects, which is introduced by extension of the notion of contributory causality. The possible "lossiness" of probabilistic causation is shown to constitute another "blind spot" obscuring circular causality, for example in design.

Research limitations/implications – The presented argument aims to promote acceptance of circular causality. Assuming a radical-constructivist perspective, it discusses the construction of mental models of causal relationships.

Originality/value – Ignorance of circular causality has previously been attributed to preferences for description in terms of energy, and in terms of timeless logic. Additionally, this paper proposes the obscuring effect of probabilistic causality, and the possible co-occurrence of multiple "blind spots."

Keywords Reciprocity, Perception, Circular causality, Linear causality, Mutuality

Paper type Research paper

1. Background

One of the central concerns of cybernetics – indeed one of its distinguishing characteristics – is its recognition of circular causality (Dent and Umpleby, 1998). This notion has been fundamental to cybernetics since its inception as an academic field (Rosenblueth *et al.*, 1943; von Foerster, 1950) and has been proposed as a fundamental condition of living systems in general (Maturana and Varela, 1980, p. 9). Other philosophical traditions that acknowledge circular causality include general systems theory and Buddhism (Macy, 1991). Modern culture at large, however, shuns circularly causal explanations, and many natural scientists in particular reject them categorically as "fallacies" (see, e.g. Gauch, 2003, p. 184). They prefer explanatory models to be put forward in the linear terms of what has been called the "triadic relationship of causality": that is, in terms of causes, rules of transformation, and effects (Segal, 1986, p. 49ff.).

Commonplace blueprints for linearly causal descriptions include Aristotle's *causa efficiens* (because of A, B occurs) and *causa finalis* (in order to make B occur, A is required). Assuming a rule of transformation T between A and B yields the triadic chain A→T→B. *Causa efficiens* and *causa finalis* describe transformational changes, i.e., processes, and have hence been called "causes of becoming" (Bunge, 2011, p. 32). Approaching such transformational processes of becoming with formal methods of

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mathematics and logic, as science commonly does, raises a challenge because the "ideal objects" handled by mathematics and logic are immutable and timeless (Bunge, 2011, p. 45). These timeless "ideal objects" – typically arranged in linear, triadic chains – are geared to offer static descriptive statements. If they were to accommodate time, causes could be described as affected by their own previous effects, potentially resulting in ongoing self-dependent cycles, undermining the scientific objective of producing static descriptive statements. Not accommodating time, however, formal logic fails where ongoing processes (including cyclical ones) are to be recognized and appreciated. Bateson (1980, p. 65) explains: "When the sequences of cause and effect become circular (or more complex than circular), then the description or mapping of those sequences onto timeless logic becomes self-contradictory. Paradoxes are generated that pure logic cannot tolerate." Science typically deals with these challenges by downplaying or denying the time-based nature of described phenomena and by breaking circularly causal relationships into linear chains (Fischer, 2014a, p. 241). Besides its unorthodox recognition of circular causality, observer-dependency and indeterminism (Dent and Umpleby, 1998), the field of cybernetics as a whole is exposed to possible dispute due to its dependency on time. Cybernetics has been characterized as an inherently performative "forward-looking search," in contrast to the description-oriented agenda of science (Pickering, 2011, pp. 17-33). This time-basedness, in and of itself, puts cybernetics at odds with timeless logic and can lead to its rejection.

Unfortunately, the rejection of circular causality for the benefit of formal describability can be mistaken to necessitate the rejection of circularly causal explanation altogether. Authors in different fields have noticed that this leads to misapprehensions of systemic relationships and failure to recognize consequences of actions. Examples include ecological disaster brought about by the linear conceptualization of industrial resource exploitation, production and consumption (McDonough and Baumgart, 2002, pp. 27-28), economic collapse brought about by a reluctance to regulate financial markets (Soros, 2009, p. 91), and, in academic contexts like that of this author, the notion of education as a linear "knowledge transfer," analogous to banking transactions (Freire, 2009, p. 71ff.). Such misapprehensions are also used to validate the sub-ordination of design processes to the linear scientific method (Glanville, 1999).

Glanville (1999, p. 88) describes the design process as a circularly causal conversation that is "usually held via a medium such as paper and pencil, with an other (either an 'actual' other or oneself acting as an other) as the conversational partner." A designer may sketch, then look at the sketch at a different angle, see something that was not sketched intentionally, take on that new idea, produce another sketch and so on. The designer affects the sketch and the sketch affects the designer (Fischer, 2011, p. 1012). The circular causality of this scenario is subject to the obscuring "blind spots" explicated below.

To illustrate circularly causal relationships, and to demonstrate the appropriateness of circularly causal modes of description, Glanville (2000) points to thermostatic control. The temperature-sensitive switch in the thermostat is commonly portrayed as controlling the furnace (or the refrigeration device) in a linear relationship. In this view, the temperature-sensitive switch is set up to embody a transformation rule: to close the circuit below a certain room temperature and open the circuit above a certain room temperature (or the other way around in the case of a refrigerating thermostat). The temperature-sensitive switch controls the furnace; A controls B. The temperature-sensitive switch, however, will not keep the furnace powered on and running indefinitely. The purpose of a thermostat, after all, is to stabilize the temperature by way of an oscillation around the desired target temperature. Hence, once the furnace has brought the room temperature to some point beyond the desired target temperature, the heat-sensitive switch will respond to the activity of the furnace by opening the circuit again, stopping the furnace. This will allow the temperature to drop to the point where the temperature-sensitive switch closes the circuit again, and the process starts over. The temperature-sensitive switch controls the furnace, while the furnace controls the temperature-sensitive switch, in a circularly causal fashion. Encapsulating this relationship, and the self-regulatory process it produces, Figure 1 shows a conceptual thermostat, or "essential self-regulator," consisting of a heat-emitting light bulb representing a furnace with an attached heat-sensitive switch, in oscillation.

As compelling as this exemplification of circular causality may be, and as obvious as causality *per se* may seem from the perspective of everyday experience, these matters pose challenges to the search for generally agreed-upon philosophical explanation. The question of what constitutes the connection between causes and effects in the physical world, for example, or the question of how immutable objects of logic map onto time-based phenomena, or the question of how paradoxical conditions are to be dealt with are far from generally resolved, and are addressed differently from different philosophical viewpoints. It is not the purpose of this paper to resolve these philosophical challenges of causality and logic. Rather, it attempts to show why circular causality can be so easily overlooked and dismissed.

This discussion takes a cybernetic, radical-constructivist point of view (Glanville, 2012), according to which subjective experience is fundamental. In this view, observers construct models of co-occurring events that may contain causal connections. Observers may then proceed to act in accordance with such models as if causal connections act between said co-occurring events – regardless of what the nature of causality may be in the physical world, regardless of the attributed nature of transformations (such as analog or digital), and regardless of the substrate within which they unfold (such as physical or social). In accordance with this observer-dependency (von Foerster, 2003, p. 280ff.), the following explanations and diagrams are not intended to refer to relationships in the physical world. They refer to mental models constructed by observers of relationships in the observed world. Such attributions of causal relationships are subject to the make-up and focus of the observers in question, as well as to the time scale of observation. Two observers of the same tennis match, for example, may reach a linearly causal and a circularly causal description of their observations respectively, if one observer's observation lasts for one second and the other one's lasts for one minute.

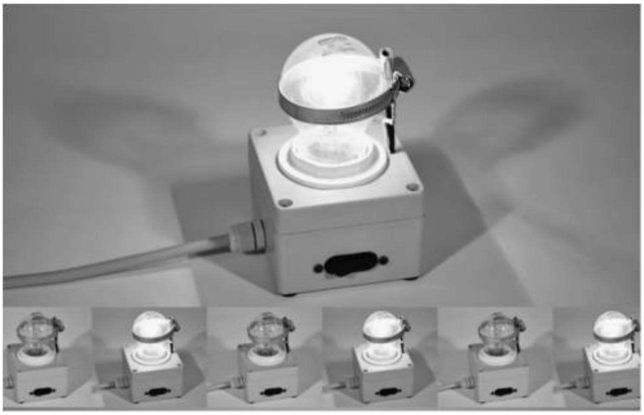

Figure 1.
A conceptual thermostat, or "essential self-regulator": a light bulb with an attached heat-sensitive switch, in oscillation

Glanville (2000, p. 4) explains that modes of causal explanation are an observer-dependent matter of choice, whereas the options available from which to choose are subject to factors such as conventions and the observer's education. Thus, a cultural context that discourages circularly causal explanation in favor of linear logic and of syllogistic portrayals of causality constitutes a "blind spot," which, in turn, obscures circular causality. In this way, avoidance of recognition of circularly causal relationships causes avoidance of recognition of circularly causal relationships, circularly. Glanville (2002, p. 4) identifies a further "blind spot" in cases of asymmetrical power relationships. He argues that observers tend to describe phenomena in terms of physics, with a focus on energy. The heat-sensitive switch supplying virtually all the electric energy passing through it to the furnace and only a very small portion of the heat energy emitted by the furnace feeding back to toggle the switch, for example, suggests a linear control relationship in this view. This aligns with the controlling role that human observers are prone to attribute to tools and utilities: the thermostat's purpose is to offer a desired temperature, which is thus seen as the output of a linearly causal translation of one form of energy into another.

2. Beyond deterministic, linear causation

This section develops a series of causal modes that transcend the linear triadic type of relationship discussed above by also recognizing circular causality, contributory causality, and – as an extension of contributory causality – collateral effects, as well as probabilistic causality. The purpose is to demonstrate how the contributory/collateral co-occurrence of deterministic and probabilistic causality can result in a further "blind spot" obscuring circular causality.

A typical linearly causal model may be visualized as shown in diagram 1 in Figure 2. A cause (arrow on the left) meets a transformation rule (circle at the center), and results in an effect (arrow on the right), corresponding to the triadic form A→T→B. As an example, consider a moving car hitting a parked car, triggering the parked car's alarm siren. If we accept that an effect can feed back as a cause to the same transformational process, then we arrive at the illustration shown in diagram 2 in Figure 2. As an example, consider the self-regulation involved in a moving car kept on a winding road by its driver. The driver observes a need to correct the car's course, corrects it, and

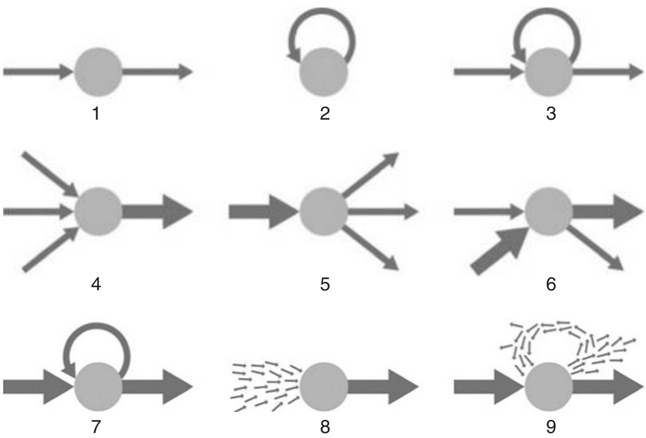

Figure 2.
Diagrams relating causes, transformation rules and effects

eventually observes a need to correct the new course, and so on. Causal relationships can exceed the idealized, minimal blueprints shown in diagrams 1 and 2 in Figure 2, and can co-occur. Consider as an example the likely damage caused by a moving car hitting a parked car. The moving car has not only an effect on the parked car, but also on itself. Multiple causal relationships can be attributed to this one instance as shown in diagram 3, some being describable in linear terms, others being describable in circular terms.

Diagram 3 implies that multitudes of causes can enter a causal transformation, as shown more clearly in diagram 4. This has been recognized in the Buddhist tradition (Lama, 2006, p. 131) with the distinction between "substantial" and "contributory" or "complimentary" causes. If a car's engine is seen as the only cause of the car's forward motion, then this constitutes a substantial cause. If a car's forward motion is seen as being caused by the working of the engine, the downward inclination of the road, a tail wind, and the intentions and actions of the driver, then these would constitute contributory causes. By extension of this notion, the notion of collateral effects can be established, i.e., the arising of multiple effects form one causal transformation, as illustrated in diagram 5. Consider, for example, the running engine of a car causing the forward propulsion of the car, the emission of sound and the emission of exhaust fumes. Both contributory causes and collateral effects may be seen as co-occurring in parallel as well as in sequence.

Co-occurring causes and effects may be perceived at different magnitudes, as is depicted in diagrams 4 through 9 with arrows of different weights. The driver of a car may attribute a greater causal relevance or magnitude to her car's propulsion arising from the car's engine than to that arising from tail wind. Likewise, on the effect side, the driver may be inclined to appreciate the car's movement to a greater magnitude than the sound emitted by it (while a sleeping neighbor may assess these magnitudes quite differently).

Co-occurring circular and linear causation may be perceived at different magnitudes (see diagram 7). As discussed earlier in this paper, the observer of a thermostat may be aware of both its linearly causal translation of input energy of one kind into output energy of another kind, and of its circularly causal self-regulation. That observer's focus on the thermostat's purpose and her tendency to describe observations in terms of energy may suggest to that observer that the linear relationship affects the process to a greater magnitude than the circular one.

From the possibility of co-occurring causes arises the possibility of probabilistic rather than deterministic causality. While a very small number of causes may bring about an associated effect in a deterministic fashion, the probabilistic mode recognizes that the occurrence of larger numbers of causes may increase the probability of associated effects (Suppes, 1970). Traffic jams, for example, are not caused by cars deterministically in the sense that some number of cars will necessarily lead to a traffic jam. The probability of traffic jams in a given environment, however, increases with the number of cars. This is illustrated in diagram 8.

Probabilistic causation is likely to involve a degree of "lossiness," which may inhibit its perception at significant magnitudes, or even obscure it altogether. This can be the case in particular when circular probabilistic causation co-occurs with deterministic linear causation (see diagram 9); which, in addition, may coincide with an observer's purpose and preference for linear description. In other words, probabilistic causation reveals another potential "blind spot" that can obscure circular causality. The attribution of causation to the thermostat is likely subject to this "blind spot," as the control loop in this example consists of a substantial, deterministic arc, which is likely aligned with its users' focus on the purposeful, linear energy conversion; and a lossy, probabilistic arc in the form of an omnidirectional dispersion of heated particles whose feedback role may likely escape its observers.

In design conversations, as discussed by Glanville (1999, p. 88) and Fischer (2014b, p. 372ff.), likewise, the purposeful articulation of ideas – for example in the form of sketches – may suggest an obvious, linear relationship between expressive effort and design output, while the lossy, probabilistic inspiration that feeds back to the designer is easily overlooked. Accordingly, the necessary overproduction of design articulations and the "lossiness" of inspiration they yield can be difficult to accept to those unfamiliar with design or with creative processes in general, and who may assume a deterministic relationship between effort and productivity in creative work, when in practice such work epitomizes circular causality.

3. Summary

Circular causality is conventionally rejected for the benefit of describability in terms of timeless logic. However, this offers no defensible grounds for the rejection of circular causality, as has been demonstrated in this paper with reference to a simple device. By establishing the modes of linear and circular causality, of contributory causes and collateral effects, of varying multitudes and magnitudes of co-occurring causes and effects, as well as of deterministic and probabilistic causality, it was shown that not only do the cultural dispositions for linearly causal description in terms of energy and of purposeful directedness constitute "blind spots" which can obscure circular causality; but also that the contributory/collateral co-occurrence of deterministic and probabilistic causality can result in a further "blind spot" obscuring circular causality-in design and elsewhere.

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