Essay

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Causality, Technology and Instruction[1]

Abstract: No teacher can proceed without the conviction that he/she can produce a change in the students he/she teaches. Causality therefore has always formed an integral part of pedagogical thinking. However, initial attempts, to incorporate causality into pedagogical theory failed. As a result, causality was then rejected. More recently, however, research in psychology, sociology, and organizational theory sought to re-introduce causality in ways that enable its incorporation into pedagogical theory. But even these efforts were not without problems. Second-order observation takes a step back from this endeavor to see what distinctions are made in attributing causes, and which ones are not.

Keywords: Causality, Causal Plan, Attribution, Medium, Observation

Nul concept physique ne peut être radicalment abstrait de son concepteur,
de même que nul phénomène physique
ne peut être radicalement abstrait de son observateur.
(E. Morin, 1977, p. 347)

After this, we are now in possession of the truism
that a description (of the universe) implies one who describes (observes it).
What we need now is the description of the "describer" or,
in other words, we need a theory of the observer.
(H. von Foerster, 1974, p. 247)

1. Introduction: Causality as a problem

If there were ever any doubt about what the central problem of pedagogy "is and must remain" (Luhmann & Schorr, 1982, p. 7), Luhmann and Schorr certainly cannot be counted among those who share it. This is the problem of the inclusion of the concept of causality in the theory of instruction/teaching. Nor do they hesitate to declare that

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they have a clear idea of what the problem involves, and that this puts them in a position to attempt a productive solution. The central problem of pedagogy, they say, is how to reconcile the concept of causality with a subject who is free. In Luhmann and Schorr's words (1982), "no teacher [Erzieher] can manage without the assumption that he has possibilities of changing the one he teaches. A rejection of causality would be equivalent to a rejection of the role of the teacher" (p. 7). But they also recognize that this is a position that has encountered serious objections, even from the very beginning, because the person upon whom the teacher is trying to cause a change through his teaching is a free being. By the year 1800, which is after Kant, it was generally acknowledged that 'causal action' upon a free being was more than problematic, and that this meant that any instructional/teaching theory (pedagogy) that wished to try to account for this type of action was doomed to failure. The ultimate result for theory was resignation, and a loss of interest in the attempt to do the apparently impossible. Luhmann and Schorr, however, refuse to see the value of leaving things in this state and believe that a new attempt at addressing the problem would certainly repay the effort. They believe they can do this because subsequent developments in sociology, psychology, and organizational theory permit them to view the traditional causal problematic as incorrectly formulated. The problem here, say Luhmann and Schorr, results from the fact that causality has been interpreted from a purely natural scientific standpoint. And to this (empirical) way of thinking causality aims at, "creating a univocal relation between specific 'causes' and specific 'effects'" (Cassirer, 1923/1997, p. 61). In other words, the goal is to identify *fixed* relations between events, because these are the ones that are intersubjectively verifiable and permit explanation and prediction, the attributes that confer scientific status. In fact, as Taylor indicates, causation can be understood in two ways. In the first, "causation […] is exemplified in the relationship between certain events, processes, or states" (Taylor, 1963, p. 21), while in the second, "in the action of agents" (Taylor, 1963, p. 21). Furthermore, "It is now generally supposed […] that the former view is the correct one, and that the causation of events by agents […] can be understood only in terms of a causal relationship between certain events, processes, or states" (Taylor, 1963, p. 21).

This modern (natural scientific) understanding consciously distances itself from the original idea of a cause as a substance that produces something else (another substance). This de-substantialization (de-personalization) of causes (and, by extension, of effects) meant that the relationship between causes and effects was something objective, within the causes and effects themselves. It also determined the sense in which this relationship obtained. As objective, as de-substantialized, causality had to obey laws. In Davidson's (1980) words, "where there is causality, there must be a law; events related as cause and effect fall under strict deterministic laws. (We may term this the Principle of the Nomological Character of causation.)" (p. 208). Or in Luhmann's words, "thus it is primarily science's experiences with the causal model to which we must adhere today if we want to clarify what is really presumed when causality is assumed in concrete operations (even in the operations of science itself)" (Luhmann & Schorr, 1982, p. 42). But eventually this requirement of strict determinism came into question when its applicability extended beyond the domain of the natural sciences. This has been remarked by

Davidson, as well as by Luhmann. The reason here is that if it were the case that human actions were governed by laws – a strict causal determinism – they would always occur in the same way, and for everyone, every time, given the same conditions. Since this is not the case – since even the same person can act differently at different times, given the same conditions – a rethinking of the notion of causality is in place, which then leads to the question: how is this re-thinking to be accomplished? Luhmann and Schorr certainly think that they know the answer. "To start with," they say, "we propose to stop looking for objective causal laws in interpersonal relations, and instead to ask: what are the causal ideas on the basis of which human beings act?" (Luhmann & Schorr, 1982, p. 18). Social psychologists, for instance, already dealt with this matter by shedding a very helpful light on the problem.[2]

In their investigation of social action they established important distinctions concerning the concept of causality. Heider (1958, pp. 100–109), for instance, introduced the difference between personal and impersonal causality, which differ in terms of the kinds of conditions that obtain in each case. The former can vary, the latter cannot. Heider illustrates this in the following way:

> "When I am threatened by a danger from a non-personal source, all I usually need to do is change the conditions in order to escape the danger. If I am threatened by falling stones on a mountain, I can get out of the danger area and seek shelter. *The stones will not change their paths in order to find me behind the shelter.* If, however, a person wants to hit me with a stone and he can run faster than I can, I am exposed to the danger of being hit to a much greater degree and I have to use very different means in order not to be hit." (Heider, 1958, p. 101)

It's clear that in the first case (impersonal causality), the conditions of the outcome (effect) do not vary, while in the latter case (personal causality), they do. Heider (1958) says that what distinguished personal causality from the impersonal kind is what he calls *equifinality:* "that is, the invariance of the end and the variability of the means" (p. 101). This distinction is echoed by Weiner (1986) in his insistence that, "some [causes] fluctuate while others remain constant" (p. 46). And Weiner (1986) emphasizes a further important distinction within the concept of causality, viz., that "causes are constructions imposed by the perceiver (either an actor or an observer) to account for the relation between an action and an outcome" (p. 21). Causes, then, in this sense are something necessarily constructed by the perceiver in terms of contingent patterns – i. e., à la Luhmann, otherwise possible – due to the essential variability inherent in the causal relationship in this case. The contingent pattern construct is expressed by Kelley (1973) as a causal schema, which for him is, "a general conception the person has about how certain kinds of causes interact to produce a specific kind of effect. Each schema can be described in terms of a hypothetical matrix" (p. 151). Social action can then be shown to involve sev-

2 The sources that Luhmann and Schorr recommend here are Heider (1944, 1958); Jones (1972); Meyer (1973); Kelley (1973) and Weiner (1974).

eral factors which uniquely characterize it. In contrast to the understanding of causality in the natural sciences, the causality of social action is subjectively constructed, indeterminate, and hypothetical. As subjectively constructed, the perceiver must select from among a plurality of causal relations which can always be otherwise. The selection is imposed not only by the fact that all causal relations cannot be realized at any time, but also by the fact that, "one's own experience and action [require] a basis that is available in a readily enough fashion and adequately univocal" (Luhmann & Schorr, 1982, p. 18). The indeterminacy and complexity of social action requires selections (attributions) in the form of causal schemata, which are called "causal plans" by Luhmann and Schorr (1982, p. 18) for whom these are not only "abbreviations" (selections), but also as such "false" because they compel the perceiver at some point to stop the search. In every case this means that, "particular or a few factors are distinguished as 'the' cause or 'the' effect at issue in specific situations" (Luhmann & Schorr, 1982, p. 18). And it is only because of these selections – that *these* factors are singled out in any case as "the" cause of an action and "the" effect (outcome) – that attributions are possible at all. In each case the perceiver has to employ a causal plan to explain the action of another because of the indeterminacy and complexity of causal factors inherent in social action as such.

Causal plans are important for Luhmann and Schorr because when combined with intentions they are responsible for technologies. They indicate that the concept of technology possesses a tradition that goes back to antiquity. But they also emphasize that there is a distinct modern conception of it in which technology designates, "the science of the causal relations that underlie practical intentions, and which action must follow if it wishes to be successful" (Luhmann & Schorr, 1982, p. 11). In the 18th century, when this interpretation of technology took hold, the dominant concept of science was that of the natural sciences. And so the causal relations in play were viewed deterministically. In other words, the concept of technology that prevailed at the time necessitated deterministic causal laws, which action had to obey in order for a person to fulfill his/her intentions to act successfully. According to this interpretation, then, technology was simply a matter of subsumption (of an action under causal laws). This, for example, was how the "science of education" was proposed by the Philanthropists[3], and which almost immediately ran into problems. For it not only required deterministic causal relations but also applicability in the social dimension where a relationship of at least two actors meant a mutual subsumption under causal laws by each party, both for himself/herself as well as for his/her partner. This vitiated the independence of causal factors, and it meant the use of another person as a means to an end. And so, according to Kant and the German Idealists, it violated not only (the principles of) logic but also the categorical imperative. The result at the time was a proscription of technology in education theory, which lasted into the 20th century.

3 German education reformers of the late 18th century whose educational efforts were an attempt to reconcile reason and nature à la Rousseau. These include Johann Bernhard Basedow, Christian Gotthilf Salzmann, Johann Heinrich Campe, Ernst Christian Trapp, Friedrich Eberhard von Rochow, and Isaak Iselin. See for this Fritz-Peter Hager (2001, p. 421).

2. Attribution and Causal Plans

Change came through the contributions of research in the sociology of organizations and the sociology of professions. For Luhmann and Schorr the best presentation of this approach is provided by James Thompson (1967), who in describing instrumental action, says that it, "is rooted on the one hand in *desired outcomes* and on the other hand in *beliefs about causes/effect relationships* […]. Though that the extent that the activities thus dictated by man's beliefs are judged to produce the desired outcomes, we can speak of technology, or technical rationality" (Thompson, 1967, p. 14). Thompson then goes on to say that since modern society includes an infinite variety of desired outcomes for which technologies are available, it is impossible to provide a complete typology for them all. Nevertheless, he identifies three varieties that are both widespread and sufficiently different to illustrate what he means. There are 1) long-linked technologies, 2) mediating technologies, and 3) intensive technologies. By long-linked technology Thompson means a series of independent actions in which successive actions can be performed only after preceding actions have been successfully performed. The assembly line is the model for long-linked technology. Mediating technology is achieved by organizations that wish to link individuals "who are or wish to be interdependent" (Thompson, 1967, p. 16). These organizations function therefore as intermediaries. Examples of mediating technology occur in the case of commercial banks that wish to link (mediate between) depositors and borrowers, insurance companies that wish to pool risks, and telephone companies that wish to connect people that wish to call with those who wish to be called. Intensive technology – the third variety – is concerned with employing "a variety of techniques" (Thompson, 1967, p. 17) in order to achieve a change in some specific object. The clearest example of the type of organization that employs intensive technology, according to Thompson, is a hospital. Its techniques can range from x-rays and laboratory work to social or even religious services. But he also mentions that the construction industry, which requires a variety of skills and crafts to construct edifices of different types under different conditions, different uses; and even the military which requires, "a multiplicity of highly skilled capacities to be applied to the requirements of changing circumstances" (Thompson, 1967, p. 18). Common to all these examples is a rationality based on beliefs about causes and effect relationships in terms of achieving a desired end or outcome, whether this is a healthy patient, a stable and useful edifice, or victory in combat. But they also assume (sets of) conditions in order to be implemented, otherwise they remain mere abstractions. For example, technologies of mass production can be quite specific about activities involved in the production of commodities. But they say nothing about how the provision of necessary resources (raw material) occurs or about the disposal of the produced commodities. Medical technologies can be quite specific about tests, procedures, and treatments of a specific illness. But they say nothing – no cause and effect statements – about how to bring the sick to the attention of medical treatment, or about the provision of the necessary equipment, etc. If we wish to discuss these in terms of an input/output model, we can say that technologies represent what would be the through-put. They are abstractions in the sense that they can be implemented only in terms of how they are situated with respect to conditions and consequences. In the case of education, Thompson says that its technology "rests on abstract systems of belief about relationships among teachers, teaching materials and pupils; but learning theories assume the presence of these variables and proceed from that point" (Thompson, 1967, p. 19).

Since technological relationships are defined as causal ones, we seem to find ourselves back at the position of the Philanthropists. But in reality the situation has changed. In the case of systems of social actions (i. e., interaction) causal relationships are no longer understood as objective and invariable (fixed). Instead, as we have seen, causes are constructions of a perceiver (subjective) and variable. In order to be able to meet these conditions, the temporal dimension is an indispensable factor.

A consideration of the temporal dimension, however, presupposes an understanding of the concept of time itself. In this case time is understood in terms of a difference of horizons: the past and the future that are separated by the present. The present in turn is interpreted as a (locus of) decision, which permits attribution. A decision, according to Luhmann, is a process of the substitution (selection) of one unity for another; that is, of a singular possibility from among a group of possibilities assembled in relation to a problem/issue which defines them as a unity. In this way time can be driven forward, constituted through the making of decisions (in the present) because, in Luhmann's words, "[e]very decision is then the beginning of a new history" (Luhmann, 1998, p. 1010). The present is therefore both the difference and integrator of the (horizons of) the past and the future at the same time. This understanding differs radically from the traditional one of time in terms of (the difference of) something flowing and something fixed. Instead time is understood in terms of the (continual) recreation of the difference of the past and the future; in Luhmann's words, of the "continual dissolution and recombination of the unity of its own paradox, of the unity of difference of past and future" (Luhmann, 1998, p. 1010). The affect this has on causality is that it requires decisions about attribution because it is impossible to relate all causes to all effects. A selection therefore has to be made. This in turn becomes incumbent upon the observers who use causal models/schemas. Finally, in order to determine which causes produced which effects we have to observe the observers (who have used a causal model/schema) because, for Luhmann, there no longer exists a "nature" to decide this, that is, a nature that could guarantee agreement in the case of attribution.

For our purposes the temporal dimension is understood as the experience of time in terms of past/present/future (Bednarz, 1990), in which the past and the future comprise open-ended horizons of past presents and future presents.[4] What integrates this complex structure is the special role and status of the present. The present is where everyone lives, where everyone always finds themselves. It is the locus from which the (horizons of) the past and the future extend outwards. Or we could also say that it is where the past becomes the future or vice versa. And so it holds a special place in any theory of time.

4 These horizons include not only possible future presents but also the (possible) past presents that were not actual, but could have been.

Investigations of the structure of this temporal dimension have been undertaken by Husserl and by Luhmann. What is significant about their findings is that they disclose that the present is a dimension as well, and that this means that there are, “*two different kinds of present* […]: a *punctual present* in which the future continuously and relentlessly becomes the past and an *enduring present* (specious present) that rigorously separates past and future, in which we can delay and if necessary work out what ought to be” (Luhmann,1981, p. 133). The concept of dimension, however, entails extension. And so it cannot be a point, or even a collection of points, because these are without extension. Nevertheless, for the future to become the past there must be a point of transition, and this can only be (occur) in the present. Consequently, the (dimension of the) present assumes a two-fold structure. This implies a simultaneity of the two presents, which is necessary for a differentiation of structure and process. At the same time it also allows for (a necessary) permanence in the face of inevitable change. This two-fold structure is what Husserl (1928b) called the “living-present” (§ 25), what James (1970) called the “specious present” (Ch. 15), and what Luhmann (1981) calls “the presence of the present” [die Gegenwärtigkeit der Gegenwart] (p. 133). This present is only, as Husserl says, a proto-horizon. And by this he means that it is a context of availability and accessibility. It is what distinguishes the living-present from the horizons of the past and the future, which are already gone or not yet, i. e., not available and accessible. This is also the reason Husserl speaks in terms of retention and protention, instead of horizons, in respect of the present. He wishes to emphasize the difference between the determinacy of the horizon of the past and the inherent indeterminacy of the present. This present pushes apart the internal boundaries of the horizons and integrates the entire structure of time by providing the basis for what Luhmann calls the reversibility of time.

By reversibility of time Luhmann does not mean that time moves in reverse. Instead, it means that the perceiver is no longer bound to one relational model. His models can change and assume new constellations. He can do this through the (his) power of negation, which is both generalizable and reflexive. As generalizable, negation makes (affirms) one (constellational) selection and negates all others. As reflexive, negation can also be applied to itself, and what was once (originally) selected (affirmed) – constellation – can itself be negated, and the possibilities that were eliminated through the original negation can be re-actualized, *so long as they have not become part of (have faded off into) what Luhmann calls the discharged (erledigte) past, i. e., become part of the horizon of the past.* Thus what was originally intended is reversed. The living-present (specious present) is the domain (dimension) of availability and accessibility in which all this occurs; in which negateable possibilities reside. It is Luhmann’s belief that the selections made in the living-present are what drives time forward because they ultimately provide the determinacy that comprises the horizon of the past.

We can now see how this model of the living-present plays a central role in the conception of (social) technologies. The hypothetical matrix that Kelley describes – as well as Luhmann’s causal plan – is constructions that involve variability. Weiner (1986) may talk in terms of “fluctuation” (p. 46), Heider (1958) in terms of “equifinality” (p. 101), and Luhmann and Schorr (1982) in terms of “complexity” (p. 18), but they all have in mind mutable causal structures that are hypothetical, i. e., that have the status of mere possibilities that can also be changed into structures of other possibilities (reversed). As we have seen, these structures become determinate *only* by passing into the horizon of the past. Until then, the different causal possibilities remain available within the living-present for re-structuring into different possible constellations.

This state of affairs depicts action in general. And so, it applies in the case of education as well. As such, it re-introduces the concept of causality that had been abandoned by pedagogy at the end of the 18th century. But the technology in this case still represents only, i. e., at best, "operatively instituted reductions of complexity, abbreviated, actually 'false', causal plans that participants can follow in relation to themselves and in relation to other participants" (Luhmann & Schorr, 1982, p. 19). This limitation forms the basis of what Luhmann and Schorr call the "technological deficit" of education, and specifically instruction. For them, the latter is the form in which educational efforts are intensified through systems of interaction between teachers and students, most often a single teacher and a plurality of students.[5] "In systems of instruction," they say, "teachers, of course, as well as students, have rudimentary causal plans for themselves and for their counterpart" (Luhmann & Schorr, 1982, p. 19), otherwise interaction between them would be impossible. But this does not preclude important differences between the two parties. For one, there is an important asymmetry built into the instructional situation which is defined in terms of roles. "The teacher has to teach, the student has to learn, and not vice versa" (Luhmann & Schorr, 1982, p. 21). This difference is further reinforced by the fact that it is expressed in terms of age. The teacher is an adult and the student is a child. This is a difference whose importance cannot be overstated because for Luhmann and Schorr the child is the medium of education as such, understood here in Heider's (1959) sense of a loose collection of elements in need of form, i. e., in need of determination (pp. 1–34).

Heider introduces the distinction of medium and form within the context of the perception of objects at a distance. He says that in investigating perception psychology had exclusively concentrated on "sensations" and "images," i. e., on what occurs at the surface of the body and within it. The objective physical aspect of this process (perception), however, had been entirely neglected. And it is this area which he intends to investigate; in particular, what occurs between the objective (distant) source of perception and the surface of the (human) body. This area, claims Heider, is just as determinative of what we perceive as the others.

Because he is investigating the perception of objects at a distance, it is not surprising that he very often employs the sense of sight. But before this he distinguishes between processes and substrata. The perception of a stone, for instance, involves a process (of

5 It is crucial here to understand that education and instruction are not identified by Luhmann and Schorr. Education is much more broadly understood as intentional socialization, whereas instruction pertains specifically to what teachers perform in the classroom. In this regard the education/instruction difference almost exactly reflects the classical distinction between educatio and institutio

energy) and the stone, which are coordinated in a specific way. Light hits the stone and is propagated through space to the eye. The space illustrates what Heider means by the medium and the light rays are its elements. Together the medium and the stone constitute the substrata of the process of perception. The key issue at the core of this process is the form which the light rays assume.

The forms of any medium are determined (conditioned) in one of two ways, says Heider. They are conditioned either internally or externally. To illustrate what he means he uses the simple example of three sticks. If these sticks are not connected together in any way, the forces affecting them will cause them to move independently. However, were these three sticks to be bound together, the forces affecting them would cause them to move together, in the same way. Their movement would be unitary. The motion of the sticks in these cases would assume *different forms.* In the first case, where the sticks were not connected together, their movement(s) (form) is a composite event in contrast to the unitary motion (form) of the sticks that are internally conditions (tied together).

The importance of the distinction of internally vs. externally conditioned events becomes evident in Heider's discussion of what he calls "spurious units" (Heider, 1959, p. 6). In the example(s) that Heider uses to illustrate the difference between composite and unitary events, the composite ones are those in which every part has its own separate causal influence, and unitary events are those in which this is not the case because each part has its cause in the preceding part (event). And so, in the case of composite events there is a plurality of independent causes constituting the event, in the way that a ball continuously moved by a hand over a plane surface has its position determined at all times (at any point of its movement) externally caused by the hand. Whereas a ball that is moved simply by an initial push has its position on the surface determined at any time (any part of its trajectory) by the preceding direction and force of the ball itself. There is no external force (cause, hand) determining its position. Composite events are the ones where the ball is moved by the hand over the surface, unitary ones are those that have an initial cause.

Now in order to relate this to thing and medium Heider uses the example of a sound vibration. Take the case of a tuning fork, he says. When struck, it causes the medium (in this case the surrounding air) to vibrate. It beats the air repeatedly. Each one of these beats is a separate cause of motion of the air (the medium). Taken altogether these beats compose a wave vibration that we hear as a unitary sound. But because each beat has a separate cause of the wave vibration, the wave is a composite event, even though we hear it as a unitary event! Why is this so? Well because of two things, says Heider: (1) the beats possess the same "geometrical characteristics" (Heider, 1959, p. 6) as a unitary event, i. e., they possess the same intervals between each one of them as if they were rigidly connected together at these intervals – *even though they aren't!;* and more importantly (2) the beats have a single (unitary) cause. In other words, no other striking of the tuning fork occurs while you hear the sound. (If it were struck again you wouldn't hear a unitary sound!) There is only one initial strike and this is responsible for all the vibrations. This is why, although the wave vibration that you hear is a composite event, you hear it as a unitary one. It's a spurious unit, i. e., a composite one perceived as a unitary one.

How does this relate to Luhmann's medium and form? A medium is like the air in the above example. It can take form, when what would be "spurious units" for Heider are "formed". This is a process of adding strictness to the loose coupling of elements. In the case of education (and science) this is the adding of form (through communication, actually interpenetration!) to loosely coupled ideas, i. e., the creation of knowledge. It is the teacher's task (role) to bring about (cause) this form through his teaching.

The asymmetry of the instructional situation therefore also entails that the factors (elements) available for selection are distributed differently. For example, "while teachers define their students in terms of variable factors in order to find points of connection for their selections, which they can steer", Luhmann and Schorr (1982) say that, "students seem to prefer to define themselves through constant characteristics" (p. 23). In this case the efforts expended by a student would represent a variable factor, while the student's natural ability, aptitude would be a constant. Luhmann and Schorr want to indicate that teachers tend to define their students in terms of the former. For instance, they might look more favorably on a less gifted student who makes a greater effort, than upon a gifted but lazy one. This, of course, does not mean that the teacher cannot focus on constant factors as well. In doing so, however, he limits the range of factors from which he can select. But by focusing on variable factors in determining his instructional technology (causal plan), he extends the range of his selections; whereas by focusing on constant factors, this range is something that is dictated to him. Students, they believe, tend to do the opposite. They define themselves, their scholastic performance, identity, in terms of constant factors, in terms of aptitude.[6]

Finally, there is the difference (for the teacher) of a double system reference. That is, "Instructional technology […] always refers, whether this is planned in or not, to personal systems and to a social system at the same time" (Luhmann & Schorr, 1988, p. 122). The effect of this double system reference (student/class) is that it discredits the notion that instruction is only a binary relation between the teacher and student. That is, it adds a dimension of complexity to any instructional technology that has to be overcome, and which thereby contributes to its inherent deficit because it means that an adequate instructional technology cannot focus solely on a binary, paired relation between teacher and student. The introduction of a second (social system) reference in this case expresses itself, as Dreeben (1970) has pointed out, not only as the need to instruct but also to, "maintain control over them [a collection of students, J. B.] both individually and collectively" (p. 52). The double system reference therefore means that an adequate instructional technology can be achieved only with the inclusion of classroom discipline. The teacher must make selections in his causal plan that addresses both references. Luhmann and Schorr admit that this does not invalidate instructional technology. But it certainly makes it much more difficult.

6 This is why students are apt to say, "I got an A on the test" and "He gave me a C".

The complexity of the double system reference therefore involves combining two focuses: an individual student/class focus as well as a constant/variable one. By combining, integrating his causal plan in this complex way the teacher can then gain a degree of flexibility that allows him to decide, for instance, "whether he wants to deal with the person at the cost of the instruction or vice versa" (Luhmann & Schorr, 1982, p. 20). But even so, Luhmann and Schorr maintain that any integration of causal plans is always a matter of trial and error. It only allows the teacher to "test" as they say, the procedures that seem correct to him, and that give him favorable chances of success. In this regard causal plans are always a work in progress for the teacher. As such, they are always in need of revision because there is certainly no guarantee that any technology will be successful at any time, or even that, when it is successful, it will be equally successful again in another situation.

In what sense then is it proper to talk about causality in this case? And what are the limitations when technologies that employ causal factors do not (always) produce the desired effect? And how do these limitations play out within the instructional context? A good place to start to look for an answer might be found in what Heider (1958) has to say about our environment. According to him, we all find ourselves in situations in which, "something happens which has to be fitted into" (p. 28), the situation. This is what he calls one of the "main features" of our environment. It is a "given" for him, and as such unavoidable both with regard to our subjective as well as our objective environments. And in both cases this is achieved through attribution. The "fitting into the situation" is therefore a matter of attribution. Or as Heider says (1958), "it [the something that happens, J. B.] has to be attributed to one or the other of the contents of the environment" (p. 28). In the case of our objective environment the contents are purely physical. And the attributions that we make are always between physical phenomena. But in the case of our subjective environments the contents include ourselves and other persons. And here when, "a new event occurs [something happens J. B.] one of the persons will be held responsible for it" (Heider, 1958, p. 28). The attribution therefore is the generator of the idea of causality. Or as Heider says (1958, p. 28), "we interpret the events as being caused" by the contents of our environments.

The main problem in attributing causes in the latter case, i. e., in the case of the subjective environment, is that, "the attributor does not possess cause and effect information for successive points in time. Rather he has information about a given effect and more possible causes" (Jones, 1972, p. 8). This situation in effect forces the attributor to attribute "according to a discounting principle" as Kelley (1973) says. In other words, in the absence of any single plausible cause for an effect, the attributor does not attribute the effect any less to any of the available plausible causal candidates. The attributor is confronted with a multiplicity of causes for a desired effect from which he must select, and the attainment of different outcomes. But fortunately this also enables the flexibility of causal plans; a flexibility that is indispensable in the case of instructional technologies because otherwise it would mean, as Luhmann and Schorr (1982) say, "that instruction gets bogged down in its own preparation" (p. 28). Unfortunately this is unavoidable in all cases where the attributor – i. e., the teacher – does not follow a situationally-relevant causal plan. Such plans are typified by what James Thompson has called an "intensive technology". These operate upon a "reacting object," or as Thompson (1967) puts it, are "determined by feedback by the object itself" (p. 17). The need for feedback, for reaction, is because this type of technology – in contrast to long-linked technologies, which wish to produce "a single kind of standard product, repetitively and at a constant rate", or mediating technologies, which merely wish to link clients and customers in standardized ways – wishes to "achieve a change in specific object" (Thompson, 1967, p. 17). This requires that causal factors are selected, combined, and ordered in different ways depending on feedback/reaction.

In the case of instructional technology, where the attributor is the teacher and the object is the student, the feedback or reaction that is required occurs when the student says something that can stimulate instruction, because it is then that the teacher has, "a *fact* in hand that is *at the same time already a personal and a classroom (social) fact,* and onto which instruction can connect" (Luhmann & Schorr, 1982, p. 28). This fact however is not guaranteed. On the contrary, it is always a matter of chance, which means that it can never be anticipated by the teacher in advance. Nevertheless, it is absolutely necessary for any instructional technology to achieve success. This means that the teacher has to learn how to exploit those occasions. He has to develop a "sensibility" to opportunities and chances, in the language of Luhmann and Schorr, or make "preparation for contingencies" in that of Smith and Geoffrey (1968). These constitute the causal factors, or means and ends in Dreebens' sense, which teachers can select and organize, and then apply, in an attempt to succeed in teaching.

Regrettably, this ability is not guaranteed either. And then this means that the teacher often has to fall back on text books and the curriculum because, "instruction of course has to continue" (Luhmann & Schorr, 1982, p. 29). But this latter kind of instruction possesses, in Luhmann and Schorr's view, little "pedagogical quality". Instead, a "genuine pedagogical technology" has to operate as a conditional program. These are concerned with causes, not effects, because causes offer the better possibility for the teacher to achieve what an instructional technology wants to do, viz., "supplement causes (inputs) with other causes (strategies) which make it more probable that desired effects occur" (Luhmann & Schorr, 1982, p. 32). This ultimately means then that the cognitive reduction (selection) of (the contingencies of) the concurrence of subjectively attributable causes that form the basis for a decision for action (on the part of the teacher) – although crucial – is not the primary question of a successful instructional technology. Instead, in order to be successful, instructional technology must concern itself with how the teacher procures causes so that their combination in complex and fluid instructional situations can be cognitively steered to attain desired effects. According to Luhmann and Schorr this can be achieved only through the creation of self-contact in social systems, i. e., through communication. The procurement of causes (inputs) for use in instructional technologies occurs only in the (communicative) interaction between teacher and student, and this requires time. And if this is the case, then Luhmann and Schorr are perhaps correct in saying that the problem of instructional technology is basically a temporal one.

3. Observation

This represents the conclusion to which Luhmann and Schorr arrived at the end of the 1970s. But causality and causal plans were subsequently affected by important changes in Luhmann's thinking and theorizing, which have to do with second order cybernetics. These changes – which appeared for the first time in the mid-1980s – significantly affect how causal plans are designed and handled (Luhmann, 2002a). Second order cybernetics refers to the developments in cybernetic thinking in the 1970s and 1980s – most prominently associated with the name of Heinz von Foerster (von Foerster, 1974) who believed, that in order to be complete, cybernetics should include itself as an object of investigation (Morin, 1977). The concept that von Foerster places at the center of his reasoning in this endeavor is that of *observation.* And it is in this sense that he characterizes the transition from Wiener's first order cybernetics to (von Foerster's) second order cybernetics as a change in focus from "observed systems" to "observing systems", whereby a cybernetics of cybernetics is attained.

Luhmann adopts and applies the second order cybernetics approach as well, starting in the mid-1980s (Luhmann, 1986), i.e., after his writings on technology, causality, and causal plans were first presented. This change in turn affects how these concepts are understood in terms of the concept of observation and the observer (Luhmann, 2002a, 1995). In other words, instead of observing "facts" as in the case of first order cybernetics, the concern now is to observe the observer. The reason underlying this, says Luhmann (2002a), is that there is no causality inherent in nature. Causality is rather a, "schema for second order observations" (Luhmann, 2002a, p. 23), which means that it depends on observations and the observations of observations; on who makes (first order) observations and who observes him. As indicated above, first order observations approach causes naively as empirical facts. Here the observer is concerned with establishing tight couplings of causes and effects. Causality then appears in terms of a Heiderian medium of loosely-coupled causal factors upon which an observer imposes form by tightly connecting these factors into causal constellations, i.e., into plans/scripts. But it is crucially important to see that this is not a case of connecting together pre-existing entities or pieces in the manner of a jigsaw puzzle. Instead, causality emerges only when the observer *successfully* connects causes and effects together. Otherwise they do not exist!

Causal plans arise only through the connection of causes and effects. But effects always relate to some future event. Strict connections therefore require correlations to the dimensions of the past and the future (Luhmann, 2002b). This situation inevitably leads to the possibility of error because it requires selective attributions, as Perrow (1984) recognized, under the condition of complexity and uncertainty. He calls this kind of error "normal accidents" (p. 5), because of this inevitability. At the same time it is necessary to note that error is possible only on the level of first order observation, i.e., when tight causal connections are made, especially for the purpose of repeated use. This second condition is important because, in addition, it transforms a causal plan, script (Luhmann, 2002b; Schank & Abelson, 1977) or cognitive map (Axelrod, 1977) into a technology, i. e., into *a process* (Luhmann, 2002a). This is important because the interpretation of technology as process constitutes the difference between the popular understanding and the one that prevails in the "field of practice of instructional technology", i. e., within the profession (Januszewski & Molenda, 2008; Kovalchick & Dawson, 2004). Repetition means repeated use or application of the same plan/script in different, even if similar, contexts/situations. Error results from the tightness, i. e., inflexibility, of the causal connections in causal plans/scripts under the condition of altered contexts/situations (Luhmann, 2002b). And once one fixes causal relations and then uses this plan/script for purposes of instruction, for instance, i. e., as an instructional technology it means that, "[…] one wants to observe and judge the act of instruction solely from this perspective" (Luhmann, 2002b, p. 45). This kind of limitation at the very least exposes the technology to errors. Of course, no one wants to be in error, to make mistakes. But this is bound to happen whenever one fixes causal relations ontologically and applies them repeatedly, i. e., whenever one operates solely on the level of first order observation. Luhmann's ways of addressing this problem is to move to the level of second order observation because it is only on this level that limitations of observation can be detected, "seen" (Luhmann, 1995).

Observation – all observation – operates with a "blind spot", according to Luhmann. In his words, this means that it "can only see what it can see. [It] cannot see what [it] cannot see. And [it] cannot see that [it] cannot see what [it] cannot see" (Luhmann, 1986, p. 52). This idea is, of course, not new. Something like this was addressed by both Brentano and Husserl, but with different results. Brentano, and following him Husserl, distinguishes between inner perception and inner observation. While he agrees that we are not able to observe present psychical phenomena (Brentano, 1955, p. 180), because, as inherently temporal, they would disappear into the past if we tried to observe them, he admits at the same time that inner perception is a 'Vorstellung' that forms part of the 'Vorstellung' that is directed to any physical phenomenon (Husserl, 1928a, § 38). For him every conscious act (Vorstellung) is accompanied by a "part-act" that is self-awareness. The reason, however, Luhmann maintains for this peculiar "blindness" is that every observation makes a distinction in order to designate one side of it for use, i. e., to 'see' what is designated as something (specific) in contrast to (eventually) everything else. In this sense the distinction forms the unity of what it distinguishes. But in executing this operation, in making this distinction, observation proceeds "naively", as Luhmann says (Luhmann, 1990, p. 85). It cannot *at the same time* see the distinction that it makes as it uses it to designate one side of it. To do so requires a further observation. And so, in making the distinction, its mode is always what Eugen Fink (1957) calls "operative", as opposed to "thematic" or "explicit".

Both Luhmann and Wittgenstein (1949) speak of observation in terms of "form". Wittgenstein says that the field of vision possesses a *form* that does not include the eye in it; by which he means that the seer (the observer) uses his eye to see, to observe whatever is in his field of vision, but that he does not see, observe, the eye as well as a part of the field. For Luhmann, every observation makes a distinction (Luhmann, 1990) and this distinction is itself a *form* (Luhmann, 1990) that creates an inside and an outside for the (its) distinction. In its most general aspect, a distinction takes the form "this and not that". In this operation, observation designates, says Luhmann (1990, p. 79), one of these two sides (viz., the "this" side) – but not the other, i. e., leaves all that is on the other side (on the "not that" side) of the distinction out of the designation. This applies, of course, in the case of causes as well. An observer designates a ("this") cause and excludes all others. The latter therefore comprise the outside of the distinction and what are left out of the designation. This is what occurs at the level of first order observation (first order cybernetics). The cause(s) so designated constitute the elements of causal plans/scripts. But it necessarily leaves out all other undesignated causes. These causes, of course, can be accessed and designated. But this requires an observation of the first order observation because of the observer's blind spot. In other words, the observer has to go back to the first (order) observation by means of a second (order) observation (of it) in order to see what the first (order) observation left out. Second order observation de-ontologizes the designation/attribution in causal plans. It rids them of the inherent naiveté of first order observations by making their distinction explicit, by making the blind spot visible. But this, says Luhmann (1995), comes at the price of ever proceeding "correctly" in the causal domain on the level of first order observation (p. 110). It also means that, "[w]henever one meets causal statements, the first question [ought to be] not whether these are correct or not but rather who has devised them and with which, for him, typical restrictions of the in themselves infinity of further inquiry" (Luhmann, 1995, p. 108). In this way, the problem of causality is transferred from the level of first order observation to that of second order observation, and becomes not one of observing and designating causes but of observing the observer who establishes causal statements/plan, in order to observe the distinctions/designations he has made and determine why and how he has made them. For without this move psychological and sociological explanations of causal statements/plans would not be possible (Luhmann, 1995). Therefore, even if in observing the observer, "[t]he theory of second order observation does not have the ambition of improving the world" (Luhmann, 1995, p. 118), it is still the (best?) means of sharpening "other instruments of observation". This ability, however, has to be purchased at the price, says Luhmann, of not being able to do any cutting itself.

Where then does second order observation leave causality, as far as pedagogy is concerned? As seen, Luhmann and Schorr (1982) rejected out of hand instructional technologies (causal plans) that were based on a natural scientific conception of causality. They tried to salvage the concept by resorting to subjective attribution. But because of the complexity of the causal situation it turned out that in this case too instructional technologies were still infected with an inherent caducity. Both of these cases, however, are matters of correct or incorrect, of the success or failure of causal plans. Instructional technologies either succeed or they do not. And usually it is not too difficult to tell the difference, almost immediately. Second order observation, however, avoids this kind of problem by making no claim to be able to redress error. But it does make it possible to discover the distinctions with which an observer operates in formulating possible causal schemas, and at the same time what is thereby excluded when he does so. When the observer observes himself – which is always possible – he, a teacher for example, at least gains the possibility of deciding perhaps to use different distinctions in the future.

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