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**CONTROL OVER WHAT? – THE USE OF SPENCER-BROWN’S CALCULUS IN
COMPLEX SITUATIONS APPLIED ON THE CONCEPTS OF MEDICINE**

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ABSTRACT

Complex situations are difficult to overlook. Not to get lost, we need clear concepts and strategies. Reading the titles of the conference the question arises who is in control of what. In the definition *what* we suppose to control lies already the strategy *how* we want to control. But the definition of the territory of control also implies as well what is out of control. The logical Calculus of Spencer-Brown has proved to be helpful to judge complex situations. When it was introduced in the sixties of the last century it was especially praised by Heinz von Foerster and was applied by many systemic thinkers as Francisco Varela, Niklas Luhmann and Fritz B. Simon.

In this paper we apply the calculus of Spencer-Brown to the concept of modern medicine. We show that a complex problem can be formally reduced to simple logic forms. In using these logical forms we may exactly define limitations of a linear concept and where and to what purpose a systemic approach is necessary.

Keywords: Calculus of Spencer-Brown, reductionism, mechanisms in medicine, definition of health, side effects

The calculus of Spencer-Brown

The calculus of Spencer-Brown has the advantage, compared to other forms of logic, that it can formalise complex phenomena in a simple way. Therefore it is especially useful in describing systemic relationships. The logical principles here presented can be applied to any complex situation. As a model we use medical thinking. We demonstrate how our definitions create a world of perception with its limitations inherent in the definitions. Understanding these limitations helps to avoid undesirable trends and the waste of resources.

The calculus of Spencer-Brown (Spencer-Brown, 1969) is plain. It is based on the assumption that every perception has two fundamental properties: distinction and indication.

In *gestalt*-theory these principles have been generally established. To perceive an object, someone has to distinguish a figure from a ground, thus creating a *gestalt*. Whatever we perceive is ‘figure’, whatever is not part of the object is ‘ground’. The same is true for every definition, for every model, for every concept. A definition is the distinction of the defined and the not defined.

The mathematical sign for a distinction is:



This mark or token distinguishes a marked state inside the rectangle (definition, model, object or whatever) from an unmarked state outside. It is as simple as it is fundamental that we can

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only make statements in defined (marked) states. Mathematically the sign means: Go in the marked state.

This procedure of going from an unmarked state to a marked state is called *crossing*. The calculus allows now only two operations. One is the repetition formulated in the ‘law of calling’: *The value of a call made again is the value of the call*. That means, if you call someone twice you call the same person. In the novel *Sinuhe the Egyptian* Mikas Waltari describes a woman, Nefer, who was so beautiful that everybody had to say her name three times: Nefernefernefer. According to the law of calling this has the same logical value as the name called once. Or if we want to explain where a dog’s muck is, we can do this by saying that it is in the left corner of the garden, we might give the exact geographic position or we might define it by its smell, but it remains the same dog’s muck. Also Andy Warhol worked a lot with this principle.

The formal sign for calling again is



The other allowed operation is the change that can only consist in leaving (*crossing again*) the marked state. This is formulated in the ‘law of crossing’: *The value of a crossing made again is not the value of the crossing*.

This again is very simple. If we state, e.g. where John is, this statement is only true for a certain space. We can define (perceive, mark) a house and look whether John is inside. If he is inside he had crossed from the unmarked state (every place that is not the house) to the marked state (the house). If he now leaves the house, he crosses again in the unmarked state and we can make no statement any more about John. We only know that he is in the ‘not-house’. With the re-crossing vanishes the value of our definition. Not only it is impossible to make a statement about John, but also the house vanishes so to speak, because the house was only of interest within the context of John.

The formal sign for crossing again is:



These two principles allow us already to build up a complex logical structure that leads to far reaching conclusions. Although the calculus of Spencer-Brown has as well a strategy to deal with recursive functions, this will not be used in our approach.

Definitions in medicine

In medicine the principles of crossing and crossing again are obvious: If someone gets ill, he is crossing in the defined state of disease and he becomes a patient. If the patient gets well again this has the value of crossing again. He becomes a normal human being about whom it can be said only that he is not a patient. As a result also the disease vanishes, because there can be no disease without a patient. Disease is, so to say, a logical placeholder that allows us to examine the status of a person.

If we now try to investigate the structure of this process, we have to start with an undefined state, which is split up with a so-called ‘*first distinction*’. Our first distinction is the separation of health and disease. As the first distinction can only separate a defined from an undefined space, we have to check first what is marked by our first distinction. The current medical approach does not speak of disease in general but only of certain, defined diseases. A look in

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a medical textbook is sufficient proof. Even in preventive medicine there is no general prevention but a prevention of certain diseases. Thus

specific disease | health

This means that statements about health are not valid in our current medical approach, because health is the undefined (unmarked) state. There are no epistemological means to observe health. It is the ground that provides room for the figure of the specific disease. This practice is in opposition to the WHO definition of health which says that disease is the absence of health. As a first step we might state that the definition of the WHO is wrong, or in milder form, that it is not in line with our current medical thinking. Statements about health are often paradox and must be so, because they are generated with a not suitable logic (Simon, 1999).

Specific interventions

Formalising therapeutic interventions, we have to take into account, that they are based on a model using a linear idea of cause and effect. A therapy is always 'specific' to a previously defined disease and to the according causal relationship. As an organism has other ways of getting well, we call these other ways 'unspecific'. Already the choice of words corresponds to the suggested formalisation

specific therapy | unspecific therapy

Specific therapy is the consequence of the specific disease and both are the result of how we observe symptoms. Healing is a change in the observed symptoms. Change means, as demonstrated before, that a value is or is not in a certain defined state. Therefore:

disease:

specific symptoms |

health:

specific symptoms |

About the non-specific (not according to the model) no statement is formally allowed. This provides however some severe problems in the judgement of therapies.

Effectiveness and Control

To prove the effectiveness of a therapy we normally use the so called double-blind test. It is a controlled therapy where one group of patients is given the real remedy and the control group is given a so called placebo, a substance that looks like the remedy but has no active substance. As neither the patient nor the administrating person knows whether it is a so called verum or placebo, both are blind. This test, however, is less sound than we usually expect. Firstly, it is not capable of discovering rare and serious side effects or side effects that occur only under certain circumstances. Contergan and Baycol are famous examples of this. On the other hand, many of the 'paradox reactions' of a therapy, i.e. effects that don't correspond to the model, were found only in extensive studies. However, these studies are carried out only

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for few substances. Thus, the CAST-study (Echt, 1991) found that antiarrhythmic drugs lead to more deaths and NaF in the therapy of osteoporosis lead to more hip-fractures, at least at a certain dosage (Riggs, 1990). This was discovered long after the substances had been on the market and had proved their effectiveness in various double-blind tests. Less drastic errors can not be detected because they slip through the large meshes of statistic measurement. This is due to the fact that we have no means to observe unexpected events except statistic evidence.

specific effect | side effect

But in the control of efficacy there is also a change in the strategy of observation. From an analytical approach we switch to a phenomenological. At this interface there is an epistemological gap. Normally we do not realise this jump over the abyss, because we are used to cover it with technical terms. When it can not be covered and the observations are not according to the model anymore, an ‘anomaly of science’ (Kuhn, 1962) arises. In medical therapy one of these irregularities is the so called placebo effect.

Placebo-Effect

People recover after receiving medicine that contains no active substance (i.e. an injection of physiological salt solution) or an active substance that is not good for the disease (antibiotics in virus infection). This is not foreseen by the model and needs explanation. But actually there is no idea how to deal with this phenomenon. It is called *placebo effect* and every medical student knows what it is or thinks (s)he knows. But there is hardly anything as enigmatic in medicine as the placebo effect. Although there exists a kind of ‘naïve realism’ in the use of the term placebo, where everybody with a wink seems to understand what is talked about. However: „Probably the biggest enemy of understanding the placebo is common sense”(Harrington, 1997, p 216). As usual in these situations, there is a call for more research on this effect and there even exists an institute to investigate it (*UCLA Neuropsychiatric Institute* <http://www.placebo.ucla.edu/>).

Mostly the placebo effect is called ‘psychic’ or ‘psychosomatic’. But that does not stand up to research. A higher suggestibility does not correspond to the responsiveness to placebos, as this hypothesis would suggest. Furthermore, the reactions to placebo follow a different pattern than reactions on suggestion and hypnosis (Gauler, 1997, pp 14-15). Nor is any other model adequate to describe the placebo phenomenon (Gauler, 1997, pp 13-28; Harrington, 1997, p. 3).

What makes the placebo effect so exciting in logical terms is that every attempt fails to pin it down or, in other words, to observe it in a ‘marked state’. Placebo research is the interesting and paradox question whether an ineffective drug is effective or not. Correspondingly, the results of placebo research are confusing:

- A meta-analysis of placebo-controlled studies, which also included a untreated group, showed that placebos are ineffective and not superior to non-treatment. The placebo group had no better effects than the non-treated (Spiegel et al, 2001).
- A meta-analysis of anti-depressive drugs showed that a verum is hardly more effective than a placebo, but both are more effective than non-treatment. (Kirsch & Sapirstein, 1998).

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This impossibility to define the placebo effect has led some scientists to despair. “In the healing process the placebo effect is ... all that what is beyond scientific explanation” (Gauler, 1997, p.42). This is true if we define ‘scientific’ as the reductionist approach. But we can see the placebo effect also as an ‘anomaly of normal science’, born out of the incompatibility of the strategy of observation and the observed process. Or as *Huntington* says: „Placebos are the ghosts that haunt our house of biomedical objectivity, the creatures that rise up from the dark and expose the paradoxes and fissures in our self-created definitions of the real and active factors in treatment.” (Harrington, 1997, p.1). This can easily be proved in formalising therapy models.

The substance to be investigated is the *verum* (V), the therapeutic model is the *specific therapy*. All interventions that are not specific according to the model are called *placebo* (P). As people are able to recover without being concerned about V and P we call this *spontaneous recovery* (S). In some definitions is $P = P + S$.

A therapy, to be serious, has to fulfil $V > P$.

If we assume a linear process, we can find a lot of combinations, depending on whether V, P and S use the same therapeutic principles, work additively, i.e. complement each or impede each other. Indications exist for every assumption. Thus, it could be proved that the opium and endorphin antagonist Naloxone is able to block placebo induced analgesia (Gauler, 1997, p. 27). *Stoessel* found in Parkinson’s disease that placebo induced about the same secretion of Dopamine in the brain as the *verum* does (de la Fuente-Fernández, 2001). Similarly *Petrovic* found the same neuronal patterns in placebo- and opoid-analgesia (Petrovic, 2002), whereas *Leuchter* found that anti-depressive drugs induce a different neuronal pattern to the placebo (Leuchter, 2002).

Theoretically, $V + P + S$ could be added to create an extraordinary healing process. Naturally the version $P + S - V = 0$ (the *verum* impedes self-healing abilities of the body) is also thinkable, but so indeed is every other combination.

The question is whether the human organism is acting according to these additions and subtractions. Indeed it would be strange if it were so. General System Theory is providing a much better model to describe and understand V, P and S (von Bertalanffy, 1969, p. 40-41) The term *equifinality* describes the reaction of an open system which tries to achieve a given set point or goal independent of partial functions. If we see health as equilibrium, appropriately balanced to the demands of environment, then the organism in disease (according to equifinality) will use quite different mechanisms to reach the set point again. It would be quite normal to see these different mechanisms interfere with each other, corresponding to their starting point. An organism in situation A_1 will ‘produce’ a different P and S and will react differently to V to one in situation A_2 . It is understandable that disease X could have other mechanisms for self-healing than disease Y, and that this self-healing is different with each V.

Again the calculus of Spencer-Brown helps us to make clear statements about specific and non specific treatments, solving all the problems constructed before. If we want to examine the relationship of specific and non specific effects, we come to the following form:



This ‘effect/side-effect’ constellation fits exactly the most widely accepted definition of the placebo effect by A. Shapiro, the father of placebo research: “We define the *placebo effect* as the non-specific, psychological, or psycho-physiological therapeutic effect produced by a placebo, or the effect of spontaneous improvement attributed to the placebo” (Harrington, 1997, p. 12).

Placebo is the logical consequence of the specific *verum* and the placebo effect is defined as the sum of undefined effects. The correct form is

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$\overline{\text{verum}} \quad \text{placebo}$

As the placebo effect is always in the unmarked state there is nothing to find out about it. A general statement on the placebo effect is therefore a logical contradiction and this explains exactly the paradoxes in placebo research. Of course there are results in the different studies about placebos and their effect. But when we look at the proceedings more formally and investigate the logical structure of double-blind test the basic problem of the specific (reductionist) approach occurs here that does not exist in the systemic approach. In the observation there is only effect or not. Every medicament is a mixture of a specific (p) and a non-specific (r) effect. The effect of the verum is phenomenological $\overline{\text{pr}}$ and not $\overline{\text{p}}$ r, as postulated. And of course also the placebo has a specific effect (q), which can be neglected and an unspecific effect (r). So placebo effect is $\overline{\text{qr}}$.

The double-blind test (outer token) measures the specific effect of verum/placebo-effect (pr) and the specific effect of placebo/placebo effect (qr). It can only measure the specific effect, because disease is in its mechanism defined as specific.

The logical form of the double-blind test is

$\overline{\text{pr} \quad \text{qr}}$

According to the law of crossing we apply the formula of ‘transposition’ (Spencer-Brown, 1969, p. 28)

$\overline{\text{pr} \quad \text{qr}} = \overline{\text{p} \quad \text{q}} \quad \text{r}$

Thus the placebo effect is again in the unmarked state. This is proof of a correct logical procedure because the placebo effect has formerly been defined as unspecific (unmarked).

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