Metapattern for complementarity modeling

Pieter Wisse

abstract

For some time now, information management is in a crisis. Odds are, you don't agree. As academics and practitioners all over seem largely unaware of the critical problem, it is often even from their best intentions they are blocking a proper solution which of course they should be welcoming and championing instead.

The crisis may be productively compared with the state of the field of quantum physics approximately one hundred years ago. From their perspective of what is now called classical mechanics, scientists were puzzled by contradictory observations. Is light *both* wave-like *and* particle-like?

Rather than continuing to try to reconcile such differences in order to arrive at a single explanation, Niels Bohr suggested a change of perspective. What we cannot change, he argued, is that light appears as *either* wave-like *or* particle-like. That is, a single, universally valid explanation simply is an illusion, period. With so-called complementarity, ambiguity dissolves; what it 'is' that we 'see' have become matters of different, mutually exclusive phenomena.

Information management is still caught at the stage of, say, naïve semantics. (It is not even classical, yet, because Socrates already knew better.) For information systems continue to be conceived on the assumption of one word/one meaning, and when it is time for information exchange the differences are supposed to take care of themselves. Well, they don't. There's no such magic to rely on.

A qualitatively different framework is required for information management in the network age. It is identified as a formally extended complementarity.

keywords

complementarity, situationism, Metapattern, Niels Bohr, Henry Folse, information modeling, conceptual modeling, semiotics, semiotic ennead, disambiguation, variety control, ontology, epistemology.

about the author

Pieter Wisse, PhD, is founder and president of Information Dynamics, Netherlands. He also was a research fellow of PrimaVera, the research program in information management at the University of Amsterdam. Pieter developed both the theoretical framework of subjective situationism and Metapattern, a practical method/language for modeling variety.

1. introduction: relevance of complementarity

Complementarity holds basic lessons for modeling variety.[1] We cannot possibly act responsibly while denying variety. For this paper, reference to relevant work is made through *The Philosophy of Niels Bohr, The Framework of Complementarity*, a study by Henry J. Folse.[2]

Niels Bohr (1885-1962) develops complementarity as a generalization of classical mechanics. He first mentions it in 1927, in a lecture. And later on he suggests its applicability far beyond understanding physics of quantum phenomena.

As far as I can judge, what Bohr misses is that from a social-psychological perspective John Dewey (1859-1952) has already outlined a yet more general ... generalization. See for example Dewey's *Essays in experimental logic*, first published in 1916.[3] In Dewey's words, behavior is inherently situational. So, same object, but different situation? Result: different behavior.

Then, with behavior also called a phenomenon, complementarity as Bohr originally thinks of it appears as a special case of – my term – situationism. The object of light can be 'seen' to exhibit either wave-like or particle-like behavior, depending on the observational set-up. As those phenomena are mutually exclusive, i.e. cannot be made to co-exist, they are, in Bohr's language, complementary.

With wave- and particle-like as the only two typical behaviors observed, complementarity in physics – to my admittedly limited knowledge of quantum mechanics, still – is believed to be limited to dualism. In social-psychological terms, though, situations with pertinent behaviors of objects are readily recognized to occur with infinite variety, with ever new situations et cetera arising. Nevertheless, it may still be called complementarity, providing in this more general sense a synonym of situationism.

Catering to such variety I developed Metapattern, a method and language for conceptual modeling.[4] For a reader familiar with Metapattern, Bohr's philosophical ideas on complementarity can be readily taken as a profound lecture, now far more generally on modeling variety.

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[1] I took my cue for this paper, hereby gratefully acknowledged, from Gavan McCarthy. In our correspondence he mentioned Karen Barad and what she calls agential realism. I followed up by reading her book *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Duke University Press, 2007). Barad appears heavily indebted to Bohr, so I moved some literature I had long since collected on Bohr's philosophical work to the top of my reading list. Frankly, now knowing Folse's more balanced account, I fail to recognize in what way agential realism differs from complementarity as conceived by Bohr, except being given another name (and much losing in clarity in the process; I find Barad's continuous show of post-this and post-that rather obstructs structural understanding).

[2] North-Holland, 1985.

[3] Dover, edition 1953.

[4] Publications since 1991, extensive documentation available on the author's website: www.wisse.cc. See also *Metapattern: context and time in information models* (Addison-Wesley, 2001). Metapattern's visual notation entails a minimum of symbols, partly changed in 2002; see *Metapattern, development of notation* (2012).
I refrain from an apology for mainly referring to my own work; it follows from the novelty of treating variety for information management in the manner here promoted.

2. priority: getting the paradigm right

The ubiquity of digital technologies has regretfully led to an ever more sterile concept of information modeling. If it is undertaken at all as a design activity, it often remains strictly oriented at getting 'technology' to do something.

How information modeling may also be called, that is, conceptual modeling, helps to emphasize that its purpose should first and foremost be to facilitate the expression of "the extension of our knowledge." Indeed, this [5]

> may lead to the recognition of relations between formerly unconnected groups of phenomena, the harmonious synthesis of which demands a renewed revision of the presuppositions for the unambiguous application of even our most elementary concepts.

Complementarity is the result of the "revision" by Bohr in order to facilitate "the harmonious synthesis […] between formerly unconnected […] phenomena." As I've already indicated, Bohr's "renewed […] presuppositions" were radically novel for physics, but elsewhere the principle of mutually exclusive, i.e. complementary, behaviors of one and the same object had already been stated.

What neither Dewey nor Bohr seems to have spent efforts on, is developing a formal method from the principle, let alone developing a language for applying such a method.[6] In hindsight, this is what Metapattern provides.[7]

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[5] In *The Philosophy of Niels Bohr*, Folse (p. 13) quotes Bohr from the latter's one-page contribution to volume 1 of *Foundation of the Unity of Science, Toward an International Encyclopedia of Unified Science*, edited by O. Neurath, R. Carnap and Ch. Morris, originally published in 1938.
I consulted the volume, too (edition 1955, reprint 1971). Why is just Bohr's short, necessarily quite vague endorsement of unity through "analysis and synthesis in science" included, and not some detailed exposition of complementarity as the unifying framework *par excellence* that Bohr has come to believe it to be?

[6] Knowing what to look for when equipped with Metapattern (and the semiotic ennead), I have identified more 'thinkers' who in this respect, as I see it, stop somewhere short. And undoubtedly there are many, many more that I don't know about, and never will. I do try to trace relevant work, and write my comments. This paper also demonstrates, as Bohr argues, "the recognition of relations." Thus, it partly is yet another work of conceptual archeology.

[7] Metapattern was developed for helping to solve problems in information management. With the scope of information exchange facilitated by digital technologies rapidly increasing, I thought of ambiguity as the critical problem for which first of all a conceptual solution was required. A modeling method/language supporting what I believed – and still believe, if at all possible, even more so – to be so-called requisite variety was given its initial description in my paper *Multicontextual paradigm for object orientation: a development of information modeling toward fifth behavioral form* (1999; original in Dutch, 1991). After naming it Metapattern, I gave a more elaborate account in *Metapattern: context and time in information models* (Addison-Wesley, 2001). Next, explicitly drawing on the semiotic triad of Charles S. Peirce (1839-1914) and more generally on the concept of the world as will and representation of Arthur Schopenhauer (1788-1860), I made Metapattern's semiotic axioms explicit in *Semiosis & Sign Exchange, design for a subjective situationism, including conceptual grounds of business information modeling* (Information Dynamics, 2002). What I propose as a conceptual framework is a semiotic ennead, providing, again using Bohr's words as quoted, "the harmonious synthesis" of ontology, epistemology and semiotics. The ennead as a conceptual framework is decidedly reflexive, with concept being one of its nine elements. It is especially the semiotic ennead which makes it possible to establish, in retrospect, relations with earlier work and using references for not only arguing for "the extension of our knowledge," but also for Metapattern as a modeling method/language to practice "unambiguous application."
Metapattern's declaration of, here continuing to use Bohr's terminology, complementarity is succinctly formulated as follows in *Metapattern: context and time in information models* (p. 5): "contexts are always assumed to be disjunct."

3. open attitude for modeling dynamic variety

Metapattern aims at any practical scope. Soon the benefits become manifest of being prepared to revise "presuppositions" for a particular model, too. It just may happen that including an additional behavior necessitates questioning how situations have so far been differentiated and/or what have so far been appointed objects.

As technocrats mistakenly believe, it certainly is not some version of a model with which they can deliver the final word on what is known, leave alone on what can be known, from then onwards. On the contrary, whatever version should always be liable to change, because having complete knowledge is impossible.[8]

Metapattern is designed as instrumental to a [9]

> conceptual framework […] to achieve the greatest possible consistent order or "harmony" in establishing the regularities observed among phenomena while also preserving the widest possible scope.

What Folse could have brought out more clearly as what he interprets as Bohr's concept of science, is that "regularities" in a "consistent order" are guided by differences. Behaviors can be explained as regular when they can be attributed to – an object behaving in – different situations. What appears contradictory, and therefore remains baffling, when a so-called independent object is required to produce behavioral variety, simply dissolves into complementary behaviors of different situated objects.[10] In other words, real differences are a matter of metaphysical acceptance, et cetera.

4. exhaustive elimination of ambiguity is impossible

A "revision of presuppositions," also read a paradigm shift, disambiguates what previously seemed an insoluble puzzle made of "apparently contrasting phenomena."[11] Folse summarizes:[12]

> [A]s the expansion of knowledge into new domains of experience brings about the often tacit casting aside of older presuppositions, a description which was once perfectly unambiguous may no longer be so, at least not until the framework itself is revised.

And, of course, it only through such a "revised […] framework" that we finally may come to recognize often even debilitating ambiguity et cetera in our knowledge of what are already known as "domains."

Actually, my criticism of currently popular frameworks is that they still aim at totally eliminating ambiguity. A corollary is objectivity as an ideal.

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[8] Bohr was led to assume complementarity in order to be able to explain discontinuity involved in the – physical – quantum. Assuming the impossibility of complete knowledge might then be considered a discontinuity of something like an opposite nature, explaining a.o. why models must be open to accommodate "the extension of our knowledge."

[9] Folse, *The Philosophy of Niels Bohr*, pp. 13-14.

[10] At least for quantum physics, complementarity was not generally accepted. Albert Einstein (1879-1955) disagreed with Bohr, arguing that behavioral synthesis is possible for a single, independent object, thereby delegating complementarity to a phase in our lack of knowledge that it is possible to overcome.

[11] Folse, *The Philosophy of Niels Bohr*, p. 14, quoting Bohr from one of his papers.

[12] *Ibid*, p. 15.

The semiotic ennead as a conceptual framework implies that in an absolute sense the goal of "unambiguous communication"[13] is illusory. In fact, a major reason for keeping a conceptual model, say, open, is that it is … conceptual, and therefore involves interpretation by an … interpreter (also read: subject). In order to limit ambiguity it may be necessary to include – reference to – particular subjects in a model.[14]

Knowledge is never complete. As a situation for specific behavior can also be specified in more detail, odds are that incompleteness involves less risk. Situation should not be confused with scale, or scope. For some behavior, a 'large' situation may already be sufficiently specific.

Corresponding to situationally differentiated behaviors of an object are contextually differentiated signs, allowing for motivationally differentiated concepts. Such is the gist of semiosis according to the metamodel (also read: framework) of the semiotic ennead.[15] It follows that reference to a "descriptive concept" is a case of mixed categories (enneadically speaking: dimensions). Anyway, methodically, Metapattern promotes that [16]

> any given descriptive concept is unambiguous in a given context in which it may be employed.

Whether ambiguity has been sufficiently dealt with, can only be determined pragmatically. Does the exchange of information so specified lead to intended behavior? For "every sign is a request for compliance."[17]

5. different paradigm, therefore qualitatively different modeling

Folse supplies an explanation why Bohr met with difficulties. For complementarity [18]

> does not easily lend itself to presentation as an argument involving a single set of logically consistent assumptions.

Does Folse really understand what complementarity involves? As a point of quite general principle, first of all, assumptions by their nature do not lend themselves to becoming established by argument. Instead, the must be … assumed, which is why they cannot escape their largely irrational character. Precisely, what is meant here is irrational in the sense of not being susceptible to … argument.

And then complementarity has this special quality. It defies all claims and expectations of complementary behaviors being explainable in a way that is overall "logically consistent." For if that were possible, such behaviors would not need to be – taken as – complementary. What different situated objects "logically" share is some "same object" from which they are behaviorally mutually exclusive situationalizations (or whatever …). Bohr, and Folse, for that matter, struggled with the question what that chameleon-like object 'is.' Below I present Metapattern's answer (with more details delegated to footnotes).

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[13] *Ibid*.
[14] For example, see chapters 7 and 8 in *Semiosis & Sign Exchange*.
[15] See chapters 2 and 4 in *Semiosis & Sign Exchange* for a detailed account of how the ennead was developed, elaborating Peirce's semiotic triad.
[16] Folse, *The Philosophy of Niels Bohr*, p. 17.
[17] This is the key assumption for my semiotic framework, see *Semiosis & Sign Exchange*, *passim*.
[18] Folse, *The Philosophy of Niels Bohr*, p. 43.

It is crucial for understanding Bohr's concept of complementarity that he does *not* equate phenomena with objects. In my words, an object comes secondary.

It is a phenomenon that is observed.[19] Only starting from such a phenomenon is it possible to distinguish between what counts as the instrument-of-observation and the object thus observed. And what 'separates' instrument and object is not, say, preordained, that is, with instrument and object each independently both contributing and responding to their interaction. Otherwise it would not be necessary to assume a phenomenon.

6. some metastructural rearrangement for extended application

My guess as to why complementarity did not really move beyond a concept in physics, is that instrument-of-observation is assumed object-like, too. With phenomenon, certainly, Bohr introduces a new category. It then takes a jump to get 'inside' a phenomenon, where what we meet all seems to belong to one and the same category, in their juxtaposition largely corresponding to the previous one and only category of objects.

Metapattern can in reverse be understood as a rearrangement, adding a third category. Rather than having a phenomenon envelop instrument and object, only to be distinguished after the envelop is opened,[20] what exists 'around' is a *situation*.[21] In Bohr's case, that would be the complete set-up for observation and measurement.
What gets interpreted at the other 'end,' is a phenomenon in a narrower sense than Bohr's. It is – therefore – better called *behavior*.
Now, who or what is doing the behavior? There may believed to be(come) something in between situation and behavior: object. It is, however, not an object *per se*, but behavior is typically attributed to a *situated object*.

It can now be recognized that with three categories, two interdependent arbitrary distinctions are involved, rather than one. Counterintuitive as it may be, this is not a problem at all. On the contrary, it allows for more precision in modeling, reducing ambiguity. What stands out in a situation as a situated object? And on the basis of that situated object, what counts as its behavior?

7. object without qualities: nil-identity

What has been gained in precision grounded on discontinuity between relevant situations requires a different concept of object. What does the continuity entail for arguing that behaviorally different situated objects do in some other sense 'belong' together? By definition

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[19] I have addressed the necessary shift in, for example, *The ontological atom of behavior: toward a logic for information modeling beyond the classics* (in: *PrimaVera*, working paper 2002-5, Amsterdam University, 2002). There, with "the classics" I mean logical atomism. As what Bohr means with classical mechanics exemplifies logical atomism, it follows that what I call "ontological atom of behavior" covers his concept of phenomenon in physics.
Please note that I don't call the shift necessary *and sufficient*. For that would imply a claim for completeness, which is impossible to justify.
[20] Schrödinger's cat?
[21] I've planned an extensive study of Dewey's relevant work for establishing conceptual connections (which I am already certain that exist, based on some preliminary reading).

it cannot be yet another situated object, for that would only lead to an infinite regression. And an unsituated object may not be regularly admitted.

Assuming a boundary value, with its inherent irrationality, is in order.[22] Again, a classically propertied object existing independently does not qualify:[23]

> [A] correspondence between phenomena and an alleged independent reality must remain forever beyond the possibility of empirical investigation. […] Instead, complementarity holds that the classical concepts refer to properties that belong only to a *phenomenal object*, the object as it is observed.

In this case, "correspondence" refers to the idea [24]

> that a theoretical representation of an isolated system is an abstraction from which one can make predictions [of different phenomena].

It is Bohr's insight,[25]

> arguing against this classical tendency to interpret the descriptive concepts which have well-defined empirical reference in application to *phenomenal* objects as also referring unambiguously to the properties of an *independently real object*,

that such a classically propertied abstraction can never be consistently conceived. And it was precisely in order to escape from an impossible mission that he revised the – encompassing – framework:[26]

> [T]alk about the properties of a transphenomenal nature is meaningless and irrelevant to science.

Metapattern's radical solution recognizes that only a behaviorally empty object can serve the cohesive purpose.[27] Its artificially attributed property is strictly limited to a nil-identity.

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[22] The title of this paragraph refers to *Der Mann ohne Eigenschaften* (English: The Man without Qualities), a novel by Robert Musil (1880-1942). In this context, qualities should be understood as properties.
[23] Folse, *The Philosophy of Niels Bohr*, p. 126, p. 138.
[24] *Ibid*, p. 126. Below I use correspondence with a different meaning, which of course should be sufficiently clear from the context ...
[25] *Ibid*, p. 140.
[26] *Ibid*, p. 135.
[27] According to Folse, Bohr actually keeps wavering, for (*The Philosophy of Niels Bohr*, p. 210)

> in [his] public statements the ontological status of the atomic system as an independent reality remains hanging in limbo between being simply a construct of theory (which Bohr means to deny in order to speak of phenomena as interactions) and the classical conception of in independently real substance possessing properties corresponding to the observable properties used to characterize our experience of its phenomenal appearances.

Folse himself is subsequently equally hesitant, or even more so, for the failure of (p. 211)

> the traditional framework [...] hardly implies that in complementarity we dispense with any reference to the nature of an independently real entity[. ...] What is does mean is that we cannot expect to describe that object as it was described in the classical framework.

Abstaining from any description of its "nature," however, is precisely what Metapattern prescribes, thereby altogether avoiding the question of whether or not a classical description can hold meaning. Folse still seems to look for an answer in the opposite direction, arguing for (p. 239)

> the theoretical abstraction of the state of the isolated system, the purpose of which is *not* to picture the properties of an independent reality (as was classically supposed) but to allow just such a complementary combination of different descriptions in order to exhaust all that can be known about the object which produces these phenomena.

However, that illusion of omniscience amounts to reintroducing the classical framework through the back door, leaving us none the wiser but even more arrogantly confused than ever. As Folse concedes (p. 244),

> [i]t is true that such structures do not permit forming a *representation* of that object. Indeed, they forbid it, but it hardly follows from this fact that we are wholly ignorant concerning such an independent reality.

A situated object should include a reference to a nil-identity.[28] When different situated objects have as one of their properties the same reference, they are considered the complementary parts of the "same object."[29]

8. more steps toward formalization: a brief tour of Metapattern

With no other behavior overlapping, there's never absolute certainty about different situated objects 'belonging' together. In fact, the concept of an object's nil-identity suggests how easily a situated object may change the attribution of its alliance. With a different reference to an equally valid nil-identity, a situated object moves form one 'family' of situated objects to another. Indeed,[30]

> [i]f one holds the view that the concept of the object existing apart from its phenomenal manifestations is meaningless, then it becomes impossible to say that descriptions of different phenomena are complementary in the sense that together they exhaust all it is possible to say about the same system, for there is no "same system" in the sense of the phenomenal objects observed. Thus it would always be possible to hold that a different set of concepts might be able to describe these different phenomena.

With three categories it is possible to establish unambiguous recursion. I would say that it has especially been the lack of such – possibilities for – distinction that kept earlier thinkers from developing a modeling formalism from their basically sound ideas about variety, et cetera. How does Metapattern make it work? Figure 1 displays how its key concepts relate.

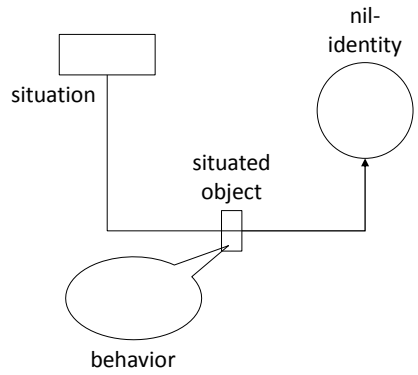

figure 1: a system of modeling concepts.

But why not just conclude, I would say – albeit from some different assumptions – along with Immanuel Kant (1724-1804), that such knowledge is beyond our capacity? It is apparently not how Folse wants to have it. On what seems very much his own authority, he insists on (p. 253)

> epistemic content [including] the purely formal structures which symbolize the [...] state of an independent object lying behind the phenomenon in terms that allow for co-ordinating different phenomenal appearances as appearances of the same object.

Again, just forget it! When Folse is right (p. 242),

> Bohr refused to be concerned with problems involving the *existence* of an independent physical reality behind experienced phenomena[. Instead,] he was very much concerned with restricting what we could *say* about it.

What we can sensibly "say about it," is simply nothing at all. Hence nil-identity, period.

[28] Thus, a nil-identity overcomes the following objection (Folse, *The Philosophy of Niels Bohr*, p. 238):

> If reference to any object other than the phenomenal object is outlawed, we can have no way of describing different phenomena as revealing different observations of the *same* object.

All it takes is that a nil-identity is added to the description of every phenomenal object.

[29] This mechanism for coordination is explained in §§ 1.11 and 1.12 of *Metapattern: context and time in information models*. See also *The pattern of metapattern: ontological formalization of context and time for open interconnection* (in: *PrimaVera*, working paper 2004-01, Amsterdam University, 2004).

[30] Folse, *The Philosophy of Niels Bohr*, p. 140.

Taking situatedness seriously, Metapattern presupposes that both situation and nil-identity as presented in figure 1 are constituted as situated objects, too. In the upward direction, a model may be elaborated as figure 3 shows. But first, in figure 2, the special case of duality of light-behavior is shown.

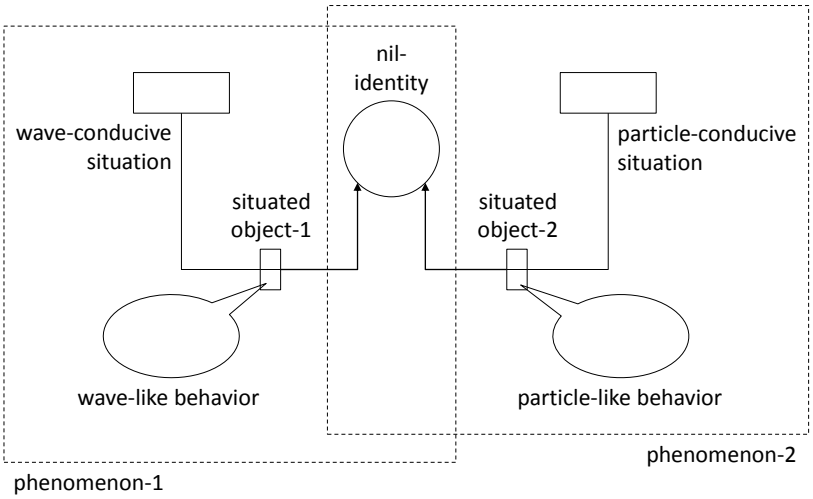

figure 2: a dual complementarity.

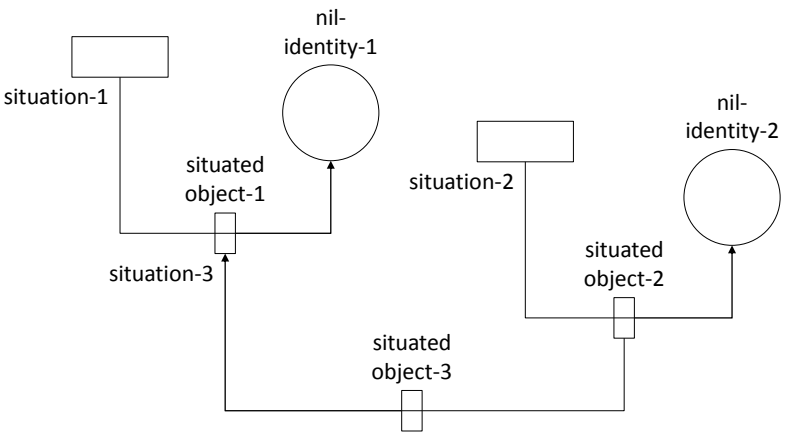

figure 3: Metapattern's upward/downward decomposition as recursion.

It is the modeler's prerogative to decide pragmatically where upward decomposition ends (and, conversely, downward decomposition begins). For a boundary, Metapattern presumes the nil-object. There are no situated objects referring to it as its parts. The nil-object, as Metapattern holds to keep its formalism as tight as possible, is its 'own' nil-situation. It can only serve as situation for situated objects answering to another nil-identity. Other nil-identities can only refer to the – nil-identity of – the nil-object as their relevant situation. The nil-object is drawn as a thick horizontal line: horizon.

Downward decomposition is actually already shown in figure 3, too. A particular node can contribute as situation and/or as object to further differentiation. Resulting in situated object-4, in figure 3 situated object-1 puts it in a situation and situated object-2 serves as its nil-identity. Please note recursion makes nil-identity derivative.[31]

[31] See "derivation between contexts" more fully explained in *Metapattern: context and time in information models* (pp. xxv-xxvi). See a.o. also *Cascading nil nodes in Metapattern* (2012) and, especially, *Get into the rhythm of Metapattern* (2013).

Rather than letting the prospect of infinite regression be an absolute show-stopper, Metapattern employs the strategy whereby recursion bounded by initial/final values makes – the recognition of – regression productive. It is common to mathematics, systems thinking, et cetera.

How conceptual models designed with Metapattern typically look is indicated by figure 4.[32]

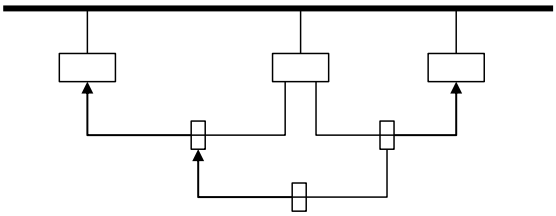

Figure 4: horizon (both nil-object and nil-situation) as a model's final orientation.

I hope I haven't bored the reader with trying to give some formal background of Metapattern. The difficulties will pay off. The continued discussion of Bohr's framework of complementarity is the clearer and far more efficient for it.

9. enneadic semiotics for ontological and epistemological precision

Folse remarked that Bohr questioned why [33]

> the object of experience has the form it presents [and that] he saw this issue entirely in the context of learning how to use descriptive terms in a way which avoids ambiguity.

As Folse wrote that, it says at least of him that he wasn't sensitive to the vital part that first and foremost context plays in "avoid[ing] ambiguity." When the term *context* is used more or less as a filler, it becomes hard to recognize an opportunity for conceptualization has been prematurely shut off.

Metapattern, on the other hand, results from radicalized awareness of context. For context is even considered the only means available for, when avoiding it altogether is impossible, at least limiting ambiguity. The semiotic ennead positions context as an element of the system of cognitive dynamics. Put simply, for an interpreter context acts as the representation of situation.

Someone 'reading' a model drawn up with Metapattern may focus on a particular node (signature). Following relationships in the direction of the arrows up to the horizon yields its context. In the other direction, i.e. against the arrows, the path of object differentiation (in Bohr's terms, also read: complementarization) is traced. This way, context-as-sign corresponds to situation-as-real. A signature corresponds to an object's nil-identity.

[32] Included as figure 4 in *Open conceptual modeling with Metapattern* (2012). For a model encompassing a large variety of phenomena with which government is concerned, see *Open system of systems' semantics practice pattern: beyond central registers etc.* (commissioned by the Office of the Dutch Standardisation Forum, Information Dynamics, 2008).
[33] Folse, *The Philosophy of Niels Bohr*, p. 53.

We can only claim to avoid ambiguity with a model on the basis of a metamodel (also read: framework) suggesting correspondence. Of course, the so-called correspondence theory of language has been rightfully criticized.

I assert that it is not the idea of correspondence that is at fault. Instead, the concept of language so far applied has been far too simplistic.[34] It shares its atomistic roots in Democritus' sense with the framework of classical mechanics that Bohr replaced with complementarity.

So, with "a renewed revision of the presuppositions" of language and its use, a revised, enneadic correspondence theory of language improves both relevance and rigor. Again, what seems to have been an obstacle for Bohr to proceed was that he recognized two, not three dimensions in knowledge. I have the impression that he sometimes conflated sign with object, and at other times sign with knowledge, making it effectively impossible to escape the confusion.[35]

Peirce already formally separated object, sign and interpretation in the semiotic triad. Considering his mention of "ground" he must have had at least a hunch of complementarity, but he also didn't develop it. That stage has been reached by extending the triad, arriving at the semiotic ennead.[36]

10. benefits of axiomatic investment

What Folse brings out throughout *The Philosophy of Niels Bohr* is Bohr's emphasis on the continued use of classical concepts for explaining phenomena. I would say it even is inherent in complementarity. In Folse's opinion,[37]

> Bohr's conviction that the new mechanics was on the right track seems to be linked to the fact that it limited, but did not discard, the classical concepts used to express the mechanical pictures. But the manner in which their use can be limited […] remained obscure.

Remember that it is discontinuity which makes impossible consistent, exhaustive explanation as behavior(s) of an independently existing object. It is the very problem that made Bohr think

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[34] Such a reversal of critical examination is precisely what Bohr practiced. Folse (*ibid*, p. 109):

> [H]e concentrated not on overthrowing these paradoxical representations but rather on removing the paradox by limiting their use [... thereby (p. 140)] avoid[ing] the dilemma that gives trouble to the epistemic interpretation.

[35] In the subtitle of her book *Meeting the Universe Halfway* Barad refers to *the Entanglement of Matter and Meaning*. The whole point of semiotics, however, is to aim at disentanglement, especially so of "matter and meaning." Otherwise the concept of sign would be meaningless right from the start. Whereas Peirce already analytically disentangles object (matter), sign and interpretation (mind) with his semiotic triad, he didn't work out a framework for synthesizing differences (although he was aware that something he called ground somehow 'made' the difference). Bohr's framework of complementarity can be recognized as an explicit attempt at a paradigm shift for synthesis, but he seems to have been semiotically naïve and therefore unable to develop it any further from his direction.
Barad, too, doesn't make any real semiotic sense. While "agential realism" sounds more fashionable, I just don't see what it offers beyond Bohr's concept of complementarity. And even emphasizing "entanglement" rules it out as a framework for information management.

[36] See chapters 2 and 4 in *Semiosis & Sign Exchange* for a detailed account of how the ennead was developed from the triad.

[37] Folse, *The Philosophy of Niels Bohr*, p. 100.

of complementarity as a solution. Then, once they are taken as different phenomena, for each phenomenon [38]

> as a special case of a wider conceptual framework which would "generalize" the classical framework

discontinuity has simply dissolved. And without that burden, classical concepts apply, albeit limited to a particular phenomenon. In fact, explaining complementary behaviors has logically become far more simple; conditions have been moved to the situation in question, leaving behavior of the situated object to be explained strictly in positive terms.[39] Folse reports that Bohr [40]

> discovered that the physical conditions necessary to define […] the wave picture always preclude those conditions necessary for an interaction which had to be described using the particle picture.

Vice versa, of course.

As I see it, it is even generally valid that [41]

> [n]o inconsistency arises […] as long as […] reference is limited to describing particular *phenomena*.

That is, only when behaviors are properly attributed to situated objects, the modeler is [42]

> not to be caught in a contradiction. […] Although [different] description[s] are not able to be applied simultaneously to the same object, a consistent use of [them] in a complementary fashion is possible because those situations which allow the[ir] application […] are mutually exclusive.

11. it's the phenomenon!

Please note that Bohr conceived of a phenomenon as interaction between objects. I favor the idea of an object acting (behaving) in a situation. Calling it interaction between situation and object, it is not quite the same as what Bohr meant. Still, the following qualification holds:[43]

> [I]n the interaction[,] the state of the [object] cannot be defined separately from that of the [situation]. This gives the interaction the feature of indivisibility which Bohr calls "individuality".

It is this phenomenal individuality which makes separating 1. situation from situated object and 2. situated object form behavior, respectively, a matter of arbitrary choice. As Bohr already indicated,[44]

> the "individuality" of the whole observational interaction makes any attempt to "subdivide" the phenomenon an *arbitrary* distinction imposed for the sake of *describing* the phenomenon of interaction as an observation of some phenomenal object.

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[38] *Ibid*, p. 101.
[39] I've repeatedly stated that situatedness implies a different logic, for example see *Ontology for interdependency: steps to an ecology of information management* (in: *PrimaVera*, working paper 2007-05, Amsterdam University, 2007).
[40] Folse, *The Philosophy of Niels Bohr*, p.102.
[41] *Ibid*, p. 102.
[42] *Ibid*.
[43] *Ibid*, p. 118.
[44] *Ibid*, p. 162.

For information management, it is the ubiquity of resources for exchange that has led to a crisis. The classical paradigm for modeling et cetera simply cannot support us to cope with real variety. It only changes when we adopt the paradigm according to which [45]

> the object to which the descriptive concepts must refer is the *phenomenal* object.

And [46]

> to do so, in the description of the phenomenon […] we must draw a "partition"

12. modeling for variety requires a new art and science

Modeling for real variety implies that the modeler cannot stop at choosing and partitioning a single situated object (analysis). S/he has to integrate (synthesis) a host of such choices. The results of analysis must already be equipped for synthesis, with synthesis a test of proper analysis. That is, analysis and synthesis are not antithetical. Instead, they are … complementary. The modeler has to 'constantly' iterate her/his mode.

Understanding complementarity as a paradigm shift may help to understand why efforts controlling variety continue to fail in the field of information management. Classical presuppositions still rule, despite projects failing again and again at often huge costs. Complementarity in an extended sense, especially with Metapattern available as a practical tool for modeling, should teach that [47]

> the classical expectation to visualize an independent reality is neither reasonable nor necessary.

Folse quotes Bohr starting his argument from [48]

> the requirement of communicability of the circumstances and results of experiments.

What should follow is recognition of [49]

> not being any longer in a position to speak of the autonomous behavior of a physical object, due to the unavoidable interaction between the object and the measuring instruments[. …] In the last resort an artificial word like "complementarity" […] serves only to remind us of the epistemological situation here encountered, which at least in physics is of an entirely novel character.

13. why not earlier?

What I find intriguing from the perspective of the history of ideas is that Bohr can be read to display his knowledge of earlier "revision of the presuppositions" in/for some discipline(s) other than physics. Yet, het doesn't mention any sources.

Could it be that he was just being overly cautious? Did he simply want to make clear he was abstaining from a judgment for which he felt unqualified?[50] The latter I find reasonable. For it

[45] *Ibid*.
[46] *Ibid*.
[47] *Ibid*, p. 123.
[48] *Ibid*.
[49] *Ibid*, continuing to quote Bohr.

explains why Bohr did not succeed, at least not formally, in developing complementarity beyond the dualism he found imposed by quantum phenomena. Had Bohr studied, for example, the work of Dewey, he would most certainly have spotted the connection,[51] et cetera.[52]
Another obstacle might have been the self-imposed demand for theoretical completeness. Experimenting with light, there had, and have, not been phenomena observed other than exhibiting either a wave-like or a particle-like character. For quantum physics it therefore seemed reasonable to consider their duality, anchored in complementarity, complete.[53]

Extending complementarity to social-psychological phenomena, though, the number of complementary phenomena must instead be assumed infinite.[54] It is therefore simply nonsense to expect that [55]

> [a] set of complementary descriptions of different phenomena (theoretically structured so that they are regarded as exhausting all that is empirically observable about the same object) provides the justification for regarding this object as the ontological grounds of the appearances of these phenomena.

It would be impossible to model anyway, so why bother? Metapattern does agree with complementarity in that it [56]

> violates the classical descriptive ideal which co-ordinated theoretical parameters with properties of an independent reality.

But why call it a violation? In terms of destruction, for all intends and purposes it is creative. There are opportunities both through and of a new order. Yes, to benefit,[57]

> we must relearn the presuppostions governing the use of our most elementary concepts.

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[50] David Favrholdt traces several sources often associated with Bohr; see *Niels Bohr's Philosophical Background* (The Royal Danish Academy of Sciences and Letters, 1992). Such associations are dismissed as myths.
[51] Another meaning of correspondence.
[52] Yet Folse remarks that later on in his life Bohr's (*The Philosophy of Niels Bohr*, p. 169)

> overriding philosophical goal was to bring the lesson of complementarity to fields other than atomic physics. [...H]e was fully convinced that the generalization of the classical framework which he called complementarity would teach the lesson for revising our understanding of the description in these fields as it had in physics.

Actually, Folse applies complementarity to explain differences of a person's social behavior (*The Philosophy of Niels Bohr*, pp. 249-250) that I find remarkably similar to how I a few years later tried to build a case for using Metapattern; see for example § 2 in *Multicontextual paradigm for object orientation* and § 1.1 in *Metapattern: context and time in information models*.
[53] When it was the claim of completeness that rubbed Einstein the wrong way, I sympathize with him. How could Bohr, or anyone else, for that matter, guarantee that no other behavioral modes 'of' light could ever be observed? But then Bohr should have remarked that complementarity's special case is unity. Without phenomenal differences it seems that a single situation applies. How could Einstein, and again, anyone else, for that matter, guarantee its singularity? That would be claiming completeness, too, this time of knowing all of the cosmos. Einstein either must have been confused or was cheating when offering "God does not play dice" for an argument. My interpretation is the opposite of what Einstein wanted to be drawn as a conclusion from it. From one throw to the next throw of the dice, and so on, circumstances (also read: situation, God-made, or not) vary, contributing to how they fall.
[54] It is the very nature of life to be adaptable. It is how we – try to – define life. Behavioral complementarity in an evolutionary sense is therefore close to a pleonasm. Or is it simply a pleonasm, period?
[55] Folse, *The Philosophy of Niels Bohr*, p. 257.
[56] *Ibid*, p. 141.
[57] *Ibid*.

But this takes the unlearning of [58]

> standards imply[ing] that a complete, objective description is one which determines the properties possessed by an independently real [….] object as a […] system isolated from any […] interaction existing in a well-defined classical […] state.

14. for living variety

Otherwise it wouldn't be a paradigm shift, now would it? But why should we take the trouble in the first place? It is because [59]

> [p]rogress […] does not require narrowing down our descriptive vocabulary to a few correct terms. Instead, real advance is made possible only by constantly widening that conceptual framework with which we first approach our experience in everyday life.

[58] *Ibid*, p. 196. The current paper, written already close to a hundred years after Bohr first made public his framework of complementarity, testifies to the difficulties of even getting it noticed.
[59] Folse, *The Philosophy of Niels Bohr*, p. 193.