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The Ontological Atom of Behavior

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The ontological atom of behavior

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Abstract*:* In his book **Data and Reality**, William Kent draws attention to limiting assumptions. For practicing conceptual information modeling, however, he doesn't remove such constraints. This ontology is interpreted in terms of Russell's logical atomism with object as the core concept, i.e., as the ontological atom. The limits Kent identifies are surpassed through a shift of ontological atom from object to behavior. Logical atomism thus transformed is characteristic of subjective situationism.

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1. Introduction

William Kent's **Data and Reality**, originally published in 1978, is a classic text on conceptual modeling. It is painful, but surely the least damaging for me to do so right away, to admit that I only read his insightful, important book in the middle of the year 2002. What kept me? Over the years, of course I have frequently seen it referenced to. Yet, no author I have consulted so far has written so enthusiastically about Kent's work as to persuade me that reading **Data and Reality** was absolutely necessary. So I didn't rush out to a library. Or borrow it from a friend, colleague, or whomever. Still my interest was sufficiently stimulated that I did try to purchase a copy. For then I could just leave it, I thought, to pick it up when I really felt like studying it. However, getting my hands on a copy was not at all easy. For a long time, a new copy was out of the question, anyway. I guess the same lack of endorsement that kept me from rushing to read it has caused the publisher to keep the book out of print. Curiously enough, even with the Internet and all, it appeared equally impossible to acquire a second-hand copy. Owners apparently value their possession and don't want to part with it. Luckily, **Data and Reality** has recently become available again 'as new.' It is distributed on an order-per-copy basis, electronically and on paper. Soon after receiving my paper copy I started to read it. And then I didn't put it down until I was finished. Especially considering they were written almost 25 years ago, today Kent's ideas are also amazingly productive.

I don't intend to review **Data and Reality** in the sense of presenting a summary. I urge everyone to read Kent's book for her- or himself. What I want to do is discuss assumptions. Kent definitely offers far-reaching proposals for conceptual modeling. However, what also makes his book a 'classic' is that several assumptions can be recognized as limiting for future information services. That is, he doesn't go far enough. I will try to point such assumptions out from the perspective of my own recent work on conceptual modeling (for example, Wisse 2001/a, 2002). This perspective makes it equally clear that Kent, in fact, already held a strong intuition about further developments in conceptual modeling.

2. Logical atomism

I believe Kent first and foremost tried to write a book for practical use. Quite rightly, he emphasizes the need for conceptual modeling as a separate "level of description." Seen in this light, **Data and Reality** is a collection of everyday conceptual pitfalls with solutions practitioners can apply to avoid them. As such, it still is extremely valuable. There is a problem, though. I take it Kent was writing for an audience of information system practitioners, rather than academics, and that he therefore refrains from an in-depth treatment of ontological issues. However, it is in the nature of conceptual modeling that sooner or later ontology is what it is 'really' all about.

As Kent doesn't systematically explain his view of reality (also read: ontology or metaphysics), it needs to be reconstructed. My impression is that, anyway for the purpose of conceptual modeling, he is actually still more in search for an ontology than reasoning from assumptions held with conviction. The area of his search is clearly visible from the perspective of so-called logical atomism. Before I make my case for this interpretation, let me first briefly discuss logical atomism itself.

An obvious place to look is Bertrand Russell's essay 'Logical Atomism' (1924). In fact, Russell starts by emphasizing — what he wants the reader to accept as — his priority:

> *I hold that logic is what is fundamental in philosophy, and that schools should be characterized rather by their logic than by their metaphysic. My own logic is atomic[.]*

Another painful admission I have to make is that, from his essay, I couldn't really get a clear idea of Russell's logical atomism. I believe he is especially arguing about how to arrange a scientific discipline as a deductive system. Such a system is

> *the set of all those propositions that can be deduced from an assigned set of premises[.]*

And those premises, or

> *first principles[, ...] are to be believed, not on their own account, but on account of their consequences. The epistemological question: "Why should I believe this set of propositions?" is quite different from the logical question "What is the smallest and logically simplest group of propositions from which this set of propositions can be deduced?"*

Russell adds that

> *errors are liable to arise from assimilating the logical to the epistemological order[.]*

I suppose Russell considers logical atomism his doctrine of logical order. Then, for a productive logical order,

> *substitute constructions out of known entities for inferences to unknown entities.*

I won't pretend to grasp his maxim. What I faintly seem to recognize, from a deconstruction perspective, is that Russell means that in logic "known entities" ultimately are reducible to logical atoms. But what are his — types of — logical atoms?

> *I have been speaking hitherto of what it is* not *necessary to assume as part of the ultimate constituents of the world. But logical constructions, like all other constructions, require materials, and it is time to turn to the positive question, as to what these materials are to be. This question, however, requires as a preliminary a discussion of logic and language and their relation to what they try to represent.*

How is this to be taken? "Logic and language" now seem to acquire an instrumental character. Isn't Russell, after all, claiming priority for reality, i.e., for what is represented? Shouldn't philosophy always involve metaphysical inquiry, too? What 'type' of philosophy is Russell addressing? He writes:

> *The influence of language on philosophy has, I believe, been profound and almost unrecognized. If we are not to be misled by this influence, it is necessary to become conscious of it, and to ask ourselves deliberately how far it is legitimate.*

Despite several pages on — what I read as — the relationship between logic and language, Russell unerringly moves into the direction of ontological statements.

> *I confess it seems obvious to me [...] that what is complex must be composed of simples, though the number of constituents may be infinite.*

Why doesn't he use the word 'atom'? I can still only recognize that Russell's logical atomism is constructed from an ontological or metaphysical atomism. He consistently tries to return to a philosophy-as-logic but never escapes ontological issues. Another example is:

> *In addition that we do not experience simples as such, there is another obstacle to the actual creation of a correct logical language[.]*

What, then, would count as correct? Is it a one-to-one correspondence between "simple" and "word"?

> *This obstacle is vagueness. All our words are more or less infected with vagueness, by which I mean that it is not always clear whether they apply to a given object or not. It is of the nature of words to be more or less general, and not to apply to only a single particular[. ...] The defect, however, is one which it is easy to imagine removed, however difficult it may be to remove it in fact.*

Once again, such a passage confirms Russell's view of "an ideal logical language." He of course assumes reality. However, from the particular perspective of — his idea of — logic Russell argues that he cannot decide on one ontology or another. I believe it is the other way around. His assumptions include *a particular structure* of reality. It is precisely such a structure built from 'real' atoms that underlies his logical atomism. Still clinging to an appearance of philosophical priority for logic, he tentatively presents his worldview (also read: ontology or metaphysics):

> *I suggest the following as an outline of a possible structure of the world; it is no more than an outline, and it is not offered as more than possible.*

I feel this is nonsense. Ontology is not independent from logic. I rather hold that a particular logic is by definition the expression of a particular ontology. So, what did Russell start from to arrive at his logic (even though he didn't admit this 'order' himself)?

> *The world consists of a number, perhaps finite, perhaps infinite, of entities which have various relations to each other, and perhaps also various qualities.*

At the time of writing the essay 'Logical Atomism,' which was after his major works in logic early in the twentieth century, he was strongly influenced by the then recent formulation of relativity theory in physics. Russell therefore continues to describe his ontology as follows:

> *Each of these entities may be called an "event"[. ...] Every event has to a certain number of others a relation which may be called "compresence"[.]*

What, now, may be concluded for logical atomism? For the purpose of this paper I would characterize it as a doctrine which argues for, say, information atoms. More information, by definition composite or derivative in nature, may be constructed from such atoms. The information atoms correspond to 'real' atoms. And through extended correspondence, information constructs are also believed to represent 'real' constructs.

Let me just check my interpretation of Russell's concept against accepted wisdom on logical atomism. I find my criticism of Russell's priorities confirmed by A. Oliver (2000):

> *The name 'logical atomism' refers to a network of theses about the parts and the structure of the world and the means by which language represents the world.*

Oliver continues his description of logical atomism as follows:

> *[T]he meaning of our sentences is rooted in a primitive relation between simple expressions and their simple worldly bearers, the logical atoms. In a logically perfect language, atomic sentences describe configurations of these atoms, and complex sentences are combinations of the atomic sentences. [... T]here are differences in the nature of logical atoms and in the arguments for the existence of these atoms.*

B. Wolniewicz (1991) presents logical atomism as

> *a metaphysical doctrine to the effect that the world consists of 'logical atoms', i.e. of elements or parts such that none entails the presence of the other.*

What is lost here is the distinction between reality and language/logic. It seems Wolniewicz is referring to reality, only.

> *Thus logical atoms are marked by their mutual independence or separability, not [...] by their indivisibility.*

Though Wolniewicz might be confusing 'real' atoms with logical atoms, his emphasis on "their mutual independence or separability" is characteristic for logical atomism throughout.

3. Representatives

What does all this have to do with Kent and **Data and Reality**? I believe Kent attempts to fight what I here take the liberty of calling modeling myopia.

> *People in the data processing community have gotten used to viewing things in a highly simplistic way, dictated by the kind of tools they have at their disposal. [p xxii]*

About a quarter of a century after he first published these words, how "things" are viewed in information management hasn't really changed. Despite efforts at emphasizing conceptual modeling, information management generally continues to suffer from a strong technological bias. Regretfully, Kent's question

> *How badly oversimplified is the view of information in currently used data models?[p xx]*

is therefore equally relevant today. Kent wants to remain realistic, though. So, he keeps his suggestions for conceptual modeling well within the possibilities of the information technology of his days (only devoting the final chapter of his book to more fundamental conceptual innovation). He is after all writing for an audience of practitioners. Anyway, it is only by assuming such enlightened conservatism on Kent's part that he makes sense with the following constraint.

> *The problem is that we would like the representatives of two things to somehow be cleanly disjoint, to be distinctly separate from each other.[p 42]*

Essentially, he restates the axioms for logical atomism. What distinguishes Kent from, for example, Russell is that he realizes the constraint exemplifies a sacrifice in the quality of modeling. For,

> *[u]nfortunately, much of the data about something concerns its relationships to other things, and therefore comprises data about those other things as well. [... W]e can't draw an imaginary circle around a body of information and say that it contains everything we know about a certain thing, and everything in the circle pertains only to that thing, and hence the information "represents" the thing.[p 43]*

Of all people, Kent is most likely trying to convince especially himself where he writes that

> *[e]ven if we could, the concept is just too "smeared" — we need some kind of focal point to which we can figuratively point and say "this is the representative of that thing".[p 43]*

And laying additional stress on lost opportunities, Kent repeats:

> *We won't try to solve this problem. We will simply skirt the whole issue and continue to use the term "representative".[p 43]*

Or, more specifically:

> *In making types non-exclusive, we come closer to reality — and suffer the penalty of facing more of the complexities of real life. [...] But saying that this is a disadvantage is the view of the ostrich. Exclusive sets don't solve the problem; they avoid it[. p 112]*

4. From information systems to web services

I continue to recognize in **Data and Reality** demonstrations of Kent's awareness of how general application of — what I, for discussion's sake, have introduced here as — logical atomism limits conceptual modeling and ensuing practical information management. He enlists the concept of information system in order to define only a local effect for the atomic constraint.

> *A representative is intended to represent one thing in the real world, and that real thing should have only one representative in an information system. [...] Something in the real world may have several representatives in several information systems, but should have no more than one representative in each.[pp 43-44]*

This neatly fits the idea expressed in the opening sentence of **Data and Reality** which reads:

> *An information system (e.g., database) is a model of a small, finite subset of the world.[p 1]*

How I interpret Kent in retrospect is that he focuses on database technology, current and/or under development in 1978, to ground a concept of something like a multitude of localized representatives of "one thing in the real world," with such representatives distributed over separate databases annex information systems. However, even admitting continued dominance

of a technological bias, much has changed in the meantime. The separate database, or information system, is no longer the paradigmatic concept. A radical shift is underway from closed control to open interconnection. At least for the near future, the so-called web service has become paradigmatic. From the perspective of logical atomism there is actually much irony in such developments. For the traditional information system is readily deconstructed. The new atoms are the web services. But precisely the web services concept undermines the database concept as the mechanism for localizing one thing's representatives. For a single web service may need to process different representatives of one thing. This requires a conceptually grounded mechanism for differentiation between representatives, rather than relying on different databases. The latter keep representatives merely technically separate.

Again, Kent already recognizes major issues even though he continues from his orientation at databases/information systems. For example,

> *when files get integrated into a database serving multiple applications, that ambiguity-resolving mechanism is lost. The assumptions appropriate to the context of one application may not fit the contexts of other applications.[p 3]*

Kent is of course referring to the stage before the availability of integrated databases, i.e., the stage of data maintained in separate files. The shift from information system to web service can now be recognized as compounding the requirements for conceptual modeling occurring from that earlier shift, that is, the one from file to database. However, I also want to illustrate why Kent continues to offer his suggestions from the perspective of database-constrained representatives of "one thing."

> *The various people and applications using a database are likely to have different perceptions of the entities and information they are dealing with [...] Different applications use different facts about entities[. ...] Thus there is a level of description corresponding to the perceptions and expectations of various applications[. p 27]*
>
> *The integrated database is the system's analog to the real world: it is that ongoing persistent thing of which different applications may have different perceptions.[p 28]*
>
> *[The conceptual model] reflects a perception of reality held by one person or group, in the role of the database administrator. [...] Although it is a single perception of reality, it must be broad and universal enough to be transformable into the perceptions of all the applications supported by the database.[p 31]*

The concept of application, as 'applied' by Kent, still comes out as part of a framework for closed control. The suggestion seems that the number of applications accessing a particular database remains within controllable limits. The conceptual variety of "one thing" is therefore also believed to stay limited; a "database administrator" is sufficient for design and supervision. All such assumptions are undermined when boundaries dissolve. They were once effectively held up by separate databases. Web services don't prosper in an environment with conceptual boundaries implied by the technical boundaries between databases. The World Wide Web Consortium's slogan of the semantic web was designed to promote open interconnectivity through web services, replacing closed control from a separate database.

Closely related to efforts for tooling the semantic web is an interest in ontologies. It seems, however, that members of the information technology community are often unaware of the — tradition of the — philosophical concept of ontology. For example, Fensel (2001) writes:

> *Ontologies are developed to provide a machine-processable semantics of information sources that can be communicated between different agents (software and humans).*

He adds that

> *[m]any definitions of ontologies have been given in the last decade[.]*

In a philosophical sense, ontology surely is a somewhat older concept. And that is putting it mildly. The philosophical concept should equally serve development of the "semantic web," though. But, then, Fensel is not only short-sighted. As the statements quoted above demonstrate, he is also confused about ontology as a type and as an instance, respectively. Kent is only one among many authors who warns against such confusion:

> *As usual, we have to be careful to avoid the confusion between kinds and instances.[p 73]*

5. Ontological atom: from object to behavior

Elsewhere, I have at length explained my conceptual modeling suggestions for open interconnectivity (see, for example, Wisse 1999, 2001/a, 2001/b, 2002). Here, I will continue the discussion from the perspective of logical atomism. When it so clearly fails as a paradigm to support variety in conceptual modeling, what precisely needs to be improved? Can I present my own work on conceptual modeling principles in this light?

In a host of ontologies, the concept of thing — or entity, or object — may be recognized to constitute what I propose to label the ontological atom. Despite his reservations, for his concept of representative Kent, too, orients himself at "things." His expectation of inevitable shortcomings show through in statements such as these:

> *This classification problem underlies the general ambiguity of words. The set of concepts we try to communicate about is infinite (and non-denumerable in the most mind-boggling sense), whereas we communicate using an essentially finite set of words.[p 7]*

> *There is no natural set of categories. The set of categories to be maintained in an information system must be specified for that system. [...] A given thing (representative) might belong to many such categories. Not only are there different kinds of categories, but categories may be defined at different levels of refinement.[p 15]*

As I have already quoted from Kent (1978, p 43), above, he "simply skirt[s] the whole issue" of thing as an inadequate ontological atom. It is precisely this issue that needs to be resolved. If not, contradictions continue to arise in conceptual modeling and subsequently in everything that depends on a conceptual model.

What led me to deconstruct 'object' as the ontological atom was the insight that one and the same thing may nevertheless exhibit different behaviors. This makes 'behavior' the ontological atom.

Concepts of object and behavior are still insufficient for an unambiguous ontology. For the question remains what determines how an object favors one behavior over other behaviors it is potentially capable of. The answer lies in a third concept: situation. Atomic behavior corresponds to a situationally determined 'part' of an object. Again, the object is no longer atomic. Its behaviors are now atomized.

In several publications (see bibliography, below), I've attempted to optimize the conceptual economy of such an ontology by declaring situation, object and behavior all relative concepts. A particular situational object, i.e., that part of an object that is associated with a particular behavior, provides the perspective. From that perspective, behavior is constituted by objects in the sense of an explosion function. In the opposite direction, situation is a recursive function of objects.

Jumping from object to behavior as the ontological atom might appear counterintuitive. The gain is the ambiguity absorbed by the concept of behavior. It resolves the paradox inherent in the assumption of a privileged thing-word complex. For in one sense, behavior is an object, too. But in another sense, it deconstructs an object. Behavior undermines the object's absolute existence. It challenges inseparable identity. The concept of behavior, the concept I offer for it, anyway, dictates that an object only exists through situations.

Similar ontological constructs might of course have been arrived at using terminology such as Kent applies. Radical as they already are, his suggestions stop at ordering several previously distinct concepts under a single denominator. Not surprisingly, they are all subordinated to Kent's ontological atom, i.e., to thing or, as he already calls it especially in his last chapter, object. I have selected some expressions for his unifying proposals.

> *Relationships are the stuff of which information is made. Just about everything in the information system looks like a relationship.[p 73]*
>
> *A relationship is an association among several things, with that association having a particular significance.[p 73]*
>
> *Instances of relationships are things themselves, about which we may have information in the system.[p 85]*
>
> *I can't tell the difference between attributes and relationships. [...] There really does always seem to be an entity lurking behind the scenes somewhere[. pp 91-92]*
>
> *We start [...] from a unifying premise: all [...] constructs are in fact entities. Each phenomen[on], and each of [its] instances, is a distinct integral concept, capable of being represented as a unit item in a model.[p 192]*
>
> *Everything in the repository is an "object". The term is used interchangeably with "surrogate", representative", and sometimes "thing".[p 193]*
>
> *Too many of the graphical models make entities and relationships mutually exclusive by forcing entities to be points (nodes) and the relationships to be lines (edges). Then you are not permitted to draw a line between two lines, or from a line to a point. What we have done, if you must picture it, is to give each line a bulge in its middle, so that it can itself function as a node.[p 209]*

No matter how consistently object is applied as the ontological atom, it simply never succeeds in offering support for conceptually modeling behavioral diversity. A more finely-grained ontological atom is required. Its label is of course already suggested by the previous sentence: behavior. This concept retains object-like characteristics while fragmenting an object into situational parts. However, even though behavior is now the essential concept it constitutes an ontological atom nonetheless. The metapattern is therefore a variant of logical atomism, too. I repeat that the metapattern — sketched here in terms of logical atomism — is documented in detail elsewhere.

6. On interests

It is not only along the dimension of what to objectively consider a "thing" that Kent indicates constraints for conceptual modeling. He also appears keenly aware of, let me call it here, the subjective side of information. Yet, again, he merely observes. He doesn't proceed with proposals for — a method of — conceptual modeling. I believe I did (Wisse 2002). In retrospect, here I take Kent's observations as perceptive problem statements. He writes, for example:

> *The purposes of the person using an object very often determine what that object is perceived to be.[p 17]*

Kent's qualifying formulation might very well reflect his intention of *not* dealing with the issue of subjective purposes or, as I call them, interests. By writing that interests "very often determine" perception he leaves it open that, in other cases, they don't. This way, he should be licensed to refrain from the issue of subjectivity in conceptual modeling.

I believe that subjectivity's import ultimately has to be radically faced (Wisse 2002) for productive modeling. For I take it that subjective interests always determine perception, etcetera. As I also assume that only an individual person, or subject, holds interests, the expression 'subjective interests' is actually a pleonasm.

Isn't it prohibitively difficult to include the perspective of interests in a framework for conceptual modeling? It all depends on the ontological atom. I would say it is even impossible starting from the concept of object. However, the shift to behavior as the ontological atom suddenly makes it obvious. For a particular — always subjective — perception is an instance of

behavior, too. This makes the interest from which it 'originates' the corresponding situation. Especially chapters 7 and 8 in Wisse (2002) present an interest-grounded view of information.

Here, I further remark that the shift from object to behavior as the ontological atom seems to capture Wittgenstein's philosophical transition. It is what I can now call their object-oriented logical atomism that Russell and the younger Wittgenstein (1921) to a large extent shared. The older Wittgenstein (1953) considered meaning no longer as objective, but as residing in language use. In my scheme, his concept of language game simply amounts to a situation, too.

For illustrating the limits of an 'objectivist' logical atomism I've again collected some phrases from **Data and Reality**. These especially show Kent's appreciation of how subjective information 'really' is.

> *We are dealing with a natural ambiguity of words, which we as human beings resolve in a largely automatic and unconscious way, because we understand the context in which the words are being used.[p 3]*
>
> *Thus, the boundaries and extent of "one thing" can be very arbitrarily established. This is even more so when we perform "classification" in an area that has no natural sharp boundaries at all. The set of things that human beings know how to do is infinitely varied, and changes from one human being to another in the most subtle and devious ways.[p 6]*
>
> *Almost all non-trivial categories have fuzzy boundaries. That is, we can usually think of some object whose membership in the category is debatable. Then either the object is arbitrarily categorized by some individual, or else there are some locally defined classification rules which probably don't match the rules used in another information system.[p 17]*
>
> *If we really did want to define what a database modeled, we'd have to start thinking in terms of mental reality rather than physical reality. Most things are in the database because they "exist" in people's minds, without having any "objective" existence. (Which means we very much have to deal with their existing differently in different people's minds.)[p 20]*
>
> *[W]e are not modeling reality, but the way information about reality is processed, by people.[p 22]*

> *We mustn't neglect the plain and familiar ambiguities, which make their own large contribution to our communication confusion. Most words simply do have multiple meanings; we can't escape that.[p 66]*

Reading these phrases, the question returns why Kent didn't proceed to include provisions for subjectivist diversity in his approach to conceptual modeling. I can only repeat that his obstacle, and no doubt of countless others, was a logical atomism at an unproductive level of ontological atom, i.e., still formally object-oriented. The failure to address the ontological issue explicitly, and with necessary and sufficient rigor, seems to have obstructed a fundamental shift. Kent, for one, apparently thought it a realistic necessity to accept constraints.

> *Information in its "real" essence is probably too amorphous, too ambiguous, too subjective, too slippery and elusive, to ever be pinned down precisely by the objective and deterministic processes embodied in a computer.[p xx]*

> *It is customary that you, the user, know what the fields signify. The manner in which a multiplicity of users get to know, and agree about, what these data items mean is the central point of data description.[p 36]*

> *I must accept paradoxes embedded right in [my philosophy of reality. ...] I am convinced, at bottom, that no two people have a perception of reality that is identical in every detail. In fact, a given person has different views at different times[. ...] But for the purposes of survival and the conduct of our daily lives (relatively narrow purposes), chances of reconciliation [of views] are necessarily high. [...] High enough to make the systems workably acceptable[. pp 227-228]*

> *In an absolute sense, there is no singular objective reality. But we can share a common enough view of it for most of our working purposes, so that reality does appear to be objective and stable.[p 228]*

Kent concludes his book appealing that conceptual modeling needs to be — further — revised and improved for supporting variety.

> *[T]he chances of achieving [...] a shared view become poorer when we try to encompass broader purposes, and to involve more people. This is precisely why the question is becoming more relevant today: the thrust of technology is to foster interaction among greater numbers of people, and to integrate processes into monoliths*

> *serving wider and wider purposes. It is in this environment that discrepancies in fundamental assumptions will become increasingly exposed.[p 229]*

7. Final remarks

Indeed, the critical issue is to resolve "discrepancies in fundamental assumptions." There will actually always be such discrepancies. For the "thrust of technology" can be relied on to create problems as a result of solutions, and so on. There's nothing pessimistic about this. It's just a realistic interpretation of the Law of Requisite Variety (Ashby 1956).

What Kent has put his finger on is only now starting to be addressed fundamentally. For me, reading **Data and Reality** has been an inspiring exercise. I take his classic analysis of shortcomings in conceptual modeling as confirmation that an ontology such as subjective situationism (Wisse 2002) is required for handling variety in information management. In this paper, I have laid the foundation for regarding subjective situationism as a behavior-oriented logical atomism. It is therefore a logic, too.

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