XXXII

ON SYNTACTIC AND SEMANTIC CONSIDERATIONS IN THE STUDY OF RITUAL

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INTRODUCTION

To my own surprise, this paper deals with Staal's work on ritual, in particular with Staal (1989) rather than e.g. his work on Indian logic and linguistics, as e.g. Staal (1988). I know virtually nothing about Indian rituals except for what I read about them in Staal (1983; 1989), so I will not say very much about them. However, one of Staal's leading hypotheses (roughly) says that rituals should be studied as rules without meaning. It is even a motto capturing a leading idea in his work on Indian rituals and mantras, namely that one should study them without appealing to meaning. This thesis presupposes a strict distinction between syntax and semantics. This strictness shows up in the possibility to study syntax without any appeal to semantics, whereas the reverse is not possible, of course, because the meaning of an expression is dependent on the expression.

My contribution to this Festschrift will try to take away some of the naturalness of the assumption that a strict distinction can be made between form and meaning, and thus between syntax and semantics. Not that I would like to blur the distinction in every situation in which we have a natural or formal language and a model in which it is interpreted, but recent developments in philosophical logic as applied to natural languages suggest that it seems possible to have a less strict distinction which may effect a better understanding of the way language is a part of our cognitive organization. I have no idea how much of what I am going to say really bears on the main hypothesis of Staal's work on ritual. After all he underscores the point that he considers ritual as an activity rather than as a language. But here, I think, one should be careful: only if language is defined as a system of forms and their meanings, may one claim that rituals are *not* languages on the ground that they are just systems of meaningless forms. In that sense, it becomes natural to focus on rituals as systems of activity. Yet, the very fact that Staal attributes a syntax to ritual implies that it is possible to attach meanings to its expressions even if the meaning of the forms is reduced to their own form itself. One may study syntax without semantics, but that does not mean that there can be no meanings. The basic question becomes whether there are sufficiently developed theories of meaning to provide meanings to apparently meaningless forms, or whether the forms are assigned a sort of "zero-meaning" as in Chomsky's work. Staal (1989, p. 137) says that "The chief provider of meaning being religion, ritual became involved with religion and through this association, meaningful". What I will suggest is that if Staal's thesis should be modified or rejected, the opposition should not come from those who locate meaning in the area of religion and belief, but rather in deeper lying principles of cognitive organization.

Although this position might surprise him–the study of logical systems is not normally associated with the study of cognition–, it brings Staal's thesis to the very heart of semiotics, the study of formal languages, and it is from this point of view that I would like to approach his thesis.

Two models, two strategies

There are two well-known models in terms of which the relation between a teacher and his pupil can be characterized: the Socrates/Plato-model (the pupil basically agrees and tries to explain what his master taught), and the Plato/Aristotle model (the pupil disagrees and tries to reject virtually everything his teacher said). Now, Frits Staal took my final examination in logic and the philosophy of language, but he did not teach me in these fields. He taught me as the leader of the famous work group-Staal in Amsterdam in the early sixties. He was the central stimulating person and having had a mathematical training he could explain many formal aspects of the transformational-generative syntax of that period to linguistic students. During the year 1965/1966 he taught me also extra-curricularly as one of the members of an illustrous pair of teachers, Frits Staal and Richard Montague, jointly and harmoniously chairing another working group in which generative grammar and Montague grammar (not yet so called) were systematically compared. The double loyalty of a pupil to a pair of teachers makes it virtually impossible to fully apply any of the two models to one of them, certainly because the teachers did not agree: Staal was on the generative side and Montague on his own side, and there was a huge abyss between these two approaches, certainly in that period.

It is in this context, that with regard to Staal's purely syntactic approach, I would like to operate on the Plato/Aristotle-side, and on the Socrates/Plato-side with respect to Montague. Yet, with regard to Staal I shall operate on the Socrates/Plato side as well, simply because I work in a generative framework albeit combined with Montagovian model-theoretic tools. In other words, I agree basically with the sort of approach Staal advocates, but I will show that the picture of the relationship between syntax and semantics is more complicated than suggested by him and although I have no real alternative, it might be good for scholars working in his discipline to also have a more complex picture of the issues involved. As said, this is also the criticism one may have with respect to those forming theories about language just from the point of view of syntax. In this sense, my intention is to contribute to a discussion about what belongs to syntax proper and what to semantics proper. Perhaps there are certain areas in which it may be very hard or even impossible to draw a clear borderline. And if this convinces my generative teacher, he might even feel inclined to have a look at his main thesis from the point of view of this more complex picture of the relation between syntax and meaning. On the other hand, I am fully aware that he argues against those who start at the meaning side of a complex system and I agree with his strategy to first put things in the right semiotic format and making the syntactic point. My remarks are for those who are prepared to follow that move and then want to see whether or not it might be the whole story. My point will be that Staal's thesis might have to be given a more complex character, the more so because Staal employs basically the same strategy as Chomsky does in his study of natural language: to restrict oneself to a syntactic approach. If the Chomskyan strategy could be shown to fail to deliver a reasonably complete picture of the empirical domain to which his theory applies because it could be argued that some sort of semantic patterning must be drawn into the theory formation about natural language, it might also influence Staal's position.

Staal's thesis presupposes that ritual is considered as a language whose syntax is to be studied without an appeal to the notion of the meaning its forms have or can be said to have. This is not the thesis defended by Staal; we need to refine its formulation. Staal entered into the discussion about the nature of ritual seeing that people focussed on their meaning: rituals were given an interpretation. The first step by Staal was to connect interpretation with form: he put his study of the ritual in the standard semiotic form which requires that there be no semantics without syntax. At that point, he asked himself whether or not it would be possible to study ritual without any appeal to meaning. This is also fairly standard in semiotics because many logicians study the properties of their formal languages by only looking at their uninterpreted forms. They set up some axioms and some rules of inference and then look at what can be derived by applying these rules: rules without meaning. This sort of approach is called proof theoretic. That Staal is on this side is clear by his remarks on the role of syntax in natural language. He adopts Chomsky's position (1989, pp. 52–60, but especially p. 138) by arguing that in natural language the relation between sound and meaning is mediated by an unnecessarily complex roundabout system: syntax. Like Chomsky, Staal says that language is not (only) for the sake of communication and he derives from this the view that syntax is "a structured domain of specific rules which in fact makes language unlogical and inefficient. These specific rules, which are without rhyme or reason, must come from elsewhere. They look like a rudiment of something quite different. This supports the idea that the origin of syntax is ritual".

However, there is a second sort of approach to formal languages in semiotics: one may be interested in truth assignment to formulas of the language and in this case a relation is presupposed between the forms of the language and some domain of interpretation. This is the model-theoretic approach: it characterizes the conditions under which expressions are true in a certain model, i.e. with respect to a domain of interpretation. It investigates the relations between the structure of the language and the structure of the domain. Montague is nowadays considered as the chief scholar who made model theory available to the study of natural language. His central thesis, developed in different papers collected in Montague (1974) is that a natural language is a formal typed language, which means among other things that the categories of natural language are treated as syntactic expressions systematically related to semantic objects that are part of an algebraic structure attributed to a domain of interpretation. I will demonstrate how this can be done shortly. Montague assumes a one-to-one correspondence between forms and meanings and in my view this provides a means to relate semantic structures to syntactic forms, though not by taking semantic structure as a point of departure but by assuming a genuine match.[1]

Whatever the differences between proof theory and model theory, both approaches make a principled distinction between syntax and semantics and the idea is clear: keep them strictly separated. I will operate on the model theoretic side trying to show that in the analysis of a genuinely syntactic pattern, the NP VP distinction, we may hit upon underlying principles which give away the structuring of models in which we interpret expressions of this form.

Two traditions

There are two traditions in which the distinction between form and meaning is expressed explicitly. In linguistics, this insight is attributed to De Saussure (1965) who made a principled distinction between a sign and its denotation. This is used by Staal in order to strengthen his main claim: it is dependent on the split between form and meaning. Staal also underscores the importance of the Saussurean claim that the relation between a 'signe' and its 'signifiant' is conventionally determined. Of course, there are some peripheral structural ties between forms and their meanings, such as onomatopoeias, but these do not affect the claim that the relation between form and meaning is arbitrary in the sense that a different meaning could have been associated with any of the forms we have available in a language. It should be added that once the assignment of meaning has taken place, much of this conventionality is restricted by the presence of existing form-meaning pairs. But this is outside the realm for which the claim has been made.

The Saussurean tradition has merged with another tradition in philosophical logic which developed the notion of semiotics. In the semiotic tradition of the thirties the distinction between syntax and semantics (and pragmatics) was given its present standard form, as in Carnap 1958. The strict separation between the three corners of the semiotic triangle, in particular between expressions and their denotation is compatible with distinction between 'signe' and 'signifiant' as well as with the Saussurean claim of arbitrariness. This solved several problems that would otherwise burden theory formation in natural and formal languages. It enables us to develop a precise theory of inference but also a theory of reference (and hence of quantification), and in so doing one is in the process of developing a successful theory of meaning. As observed above, the distinction between syntax and semantics led to two research strategies in mathematical logic: proof theory and model theory. It is clear that Chomsky has always been siding with the proof theoreticians: he does not appeal to meaning in constructing his theories about natural language. In applying Chomsky's insights to the area of ritual Staal has retained this proof theoretic position. It also follows that my interest in Montague's work will lead to raising some problems.

Some problems

As indicated, Staal appeals to De Saussure for an important argument about the reference of linguistic expressions, in particular to his insight that the relation between a linguistic form and its reference is conventional. This insight has gained the status of one of the few axioms of linguistics. In fact, there is no way to avoid the position that the relation between linguistic form and the semantic object to which it refers is arbitrary. However, it is important to see that the Saussurean axiom is formulated with respect to basic, lexical forms, such as nouns, verbs and adjectives. As formulated, it holds only at the lexical level. As soon as we arrive at the level at which the principle of compositionality can be said to be operative, one is forced to rely on the functional nature of the rules combining basic forms into derived meanings. The most common assumption is that compositionality requires (mathematical) functions, the complex output, i.e. a structured meaning, being determined by its basic constituent members and hence the arbitrariness "percolates" as it were to the top of the tree to which the meaning is assigned.

Let me put these things in a more precise format. Interpretation in the logical-semiotic tradition that currently has been extended so as to include linguistics, can be seen as a function mapping linguistic forms onto semantic objects. The interpretation function is defined as operating on a domain consisting of linguistic forms and as yielding semantic objects which are part of the domain of interpretation. It is standard to distinguish between the interpretation of basic forms (say, lexical items) and the interpretation of complex forms: the latter are constructed from the basic forms. So, the interpretation of language forms begins by considering any form as complex breaking it down into less complex units until one arrives at the levels at which the forms can be considered basic. I will briefly discuss these two modes of interpretation and see how we can extract some arguments from it pointing in the direction suggested above.

THE INTERPRETATION FUNCTIONS I AND $[\![.]\!]$

In model theory, interpretation takes place with respect to a model. A model **M** for a language L consists (basically) of a domain of interpretation D and an interpretation function I: **M** = $\langle D, I \rangle$. The basic forms of L are interpreted by I which assigns to the constants c_α in a language L their value $I(c_\alpha)$ in the domain of interpretation D_α, where D_α is construed out of D:[2]

$$I : L_{Con} \longrightarrow D_\alpha$$

The subscript α stands for types (categories). For example, *John*$_e$ says that the proper noun *John* denotes an individual (e stands for entity); *walk*$_{et}$ says that *walk* is a predicate constant (et stands for a set), etc. In this way the categories of natural language are systematically mirrored by the types of a logical language. The domain of individuals D_e is taken here as the point of departure: all types are construed from individuals e and truth values t.

The domain D may be any domain we like. In (approaches based on) first order logic, however, D is standardly taken as a domain of individuals. Assuming that in sentences like (1) there are two basic forms *John* and *walk*, we obtain (2) as the result of applying the function I.

(1) John walks

(2) $a.$ $I(\textit{John}) = \text{John}$
$b.$ $I(\textit{walk}) = \text{W} = \{x : x \text{ move by foot}\}$

Here $I(\textit{John}) \in D_e$, that is, John is an element of the domain, and $I(\textit{walk}) \subseteq D$. That is: W is a subset of D_e, the set of all individuals. As said, I could have been given different linguistic forms as its input and yet have given the same values.[3]

Full sentences are considered complex expressions that are reduced to more simple ones. In first order predicate logic (1) is standardly interpreted as in (3):[4]

(3) $[\![\textit{John walk}]\!] = 1$ iff $[\![\textit{walk}]\!]([\![\textit{John}]\!]) = 1$ iff
$I(walk)(I(John)) = 1$ iff $I(John) \in I(walk)$ iff John $\in$ W

The sentence is considered true if and only if John is an element of the set W: $I(John) \in I(walk)$. The reduction to the I-interpretation applies to all sorts of complex forms, e.g. conjunctions like *John, Mary and Sue* and to *walk and talk*. Conjunctions are first taken as a complex form and then reduced to the basic forms which receive an I-interpretation. For example, $[\![\textit{walk and talk}]\!]$ is first reduced to $[\![\textit{walk}]\!] \cap [\![\textit{talk}]\!]$ and then to $I(\textit{walk}) \cap I(\textit{talk})$.[5] The same sort of pattern holds for disjunction, negation, quantifiers, etc.

SPLITTING THE DOMAIN

The set W in (2b) is the set of those individuals that walk in D, which means that the predicate *walk* is conceived of as a function partitioning the domain into a set W and its complement W′. This structures D. In fact, D is bipartitioned as many times as there are predicates in the language. Due to this property of predicates (a two-place predicate partitions D into a set of pairs standing in a certain relation and a set of pairs not standing in this relation, etc.) one may discern types of semantic objects in D. In modern type-logic, these structures have been dealt with extensively. The leading idea is that D is stratified by a set of functions so that different categories in the language correspond to different semantic types in the domain. It is now standard to say that $D = D_e$, i.e. the set of all individuals of type e (e stands for entity). The verb *walk* is considered as pertaining to a set W of type et (the notation represents a function sending entities e belonging to W to truth values t). It is treated as a predicate constant whose value is an element of D_{et}.

One of the things Montague (1974) taught us was that the proper name *John* is an individual constant whose value is not only an element of D_e, but also an element of the domain $D_{(et)t}$. This is the domain of functions sending sets, i.e. semantic objects of type et, to truth values t. For example, we saw that the set W was treated as a (characteristic) function sending all the entities that walk to the truth value 1 and all the entities e that do not walk to 0. Now, one may think of D as being structured into the set of all its subsets. This collection, being a set, called $\wp(D)$ may also be split by a function sending all the sets with a certain property to 1 and all the sets lacking this property to 0. In this way, $I(John)$ can be seen as the collection of sets containing all the sets of which John is an element: there are two ways of looking at one syntactic element. It makes the relation between syntax and semantics more flexible in the sense that *John* may correspond to an individual or to a collection of sets, whereas semantically an equivalence holds. Yet there is some other constant relation between form and meaning: a mathematical function.

A UNIVERSAL FORMAT

An intriguing question arises: how do we explain the fact that our interpretation has the format of a function? And again, this amounts to asking whether it is a matter of syntax or of semantics. Let me work out this question in some detail, because we need more ingredients to get to the point. Take a sentence like (4).

(4) Three children walked

Here again one needs application of I, so we end up with something like (5).

(5) $a.$ $I(\textit{three}) = 3$
$b.$ $I(\textit{children}) = \text{C} = \{x : x \text{ is a child}\}$
$c.$ $I(\textit{walk}) = \text{W} = \{x : x \text{ move by foot}\}$

However, (5a) would not work as formulated: there is structure involved in (4): (4) is interpreted with the NP analyzed as: Det N and the function $[\![.]\!]$ works, provisionally, as follows:

(6) $[\![\textit{three children walk}]\!] = 1 \Leftrightarrow$
$[\![\textit{three children}]\!]([\![\textit{walk}]\!]) = 1 \Leftrightarrow$
$([\![\textit{three}]\!]([\![\textit{children}]\!]))([\![\textit{walk}]\!]) = 1 \Leftrightarrow$
$(I(\textit{three})(I(\textit{children})))(I(\textit{walk})) = 1 \Leftrightarrow$
$\mathrm{W} \in I(\textit{three})(I(\textit{children}))$

That is, like *John* the NP *three children* is taken as a function splitting the domain $D_{((et)t)}$. In (6) $D_{((et)t)}$ is split into a collection of sets containing three children and into the complement of this collection. In (4), the function *I(three(children))* takes the set W as its input and maps it to 1 iff W contains three children in which case the sentence is true, otherwise false. This sounds rather complicated because so much machinery seems to be involved, but as I will show shortly with the help of a diagram, the basic ideas are simple.

Montague (1974) laid the foundations for the theory of Generalized Quantification that developed in the eighties. It is one of the most successful semantic theories to date, because it added significantly the scope and the depth of the insight in quantifiers among which the numeral *three*. It is taken as a determiner. Nowadays, the determiner is considered a key element in the approach to quantification. It has become standard to interpret sentence (4) in terms of a subject-predicate combination of the form NP VP yielding the interpretation that three individuals in D_e are members both of the set of children and of the set of those who walk, as shown in Figure 1.

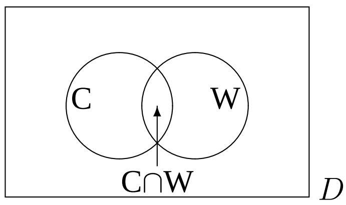

Figure 1: W is mapped to 1 if W contains three children in the intersection $C \cap W$.

What the Det *three* does is to provide a format for the interpretation of the relation between two sets expressed by elements of the sentence: the head noun of the NP in the NP VP combination denotes a set (in this case C) intersecting with the denotation (in this case W) of the VP. This appears to be a universal format available for sentences in all languages.

THREE

The English numeral *three* taken as a determiner expresses a relation between the head noun N and the VP. Yet, this format is not directly visible in the syntax of English: one of the arguments of the 'Three'-relation is part of the NP, the other argument is the VP. In other languages, the format may be expressed by different syntactic configurations. Yet, any sentence expressing that three children walked has the same format due to the universality of the meaning of the numeral. We therefore replace (5) by (7):

(7) $I(\textit{three}) = \{\langle x_{et}, y_{et}\rangle : |x \cap y| = 3\}$

That is, *three* is to be interpreted as a relation between two sets such that their intersection contains three individuals. Formally:[6]

(8) $[\![\textit{three children walked}]\!] = 1$ iff $\langle [\![\textit{children}]\!], [\![\textit{walk}]\!]\rangle \in [\![\textit{three}]\!]$

In this way, the universal format of Figure 1 is encoded in a general lexical definition that is universally applicable. Another way of expressing this is by saying that once people master elementary operations over the set of natural numbers, they have universal semantic objects looking for a name. That this name is arbitrary is a trivial matter as compared with the fact that a structure is available reflecting something of the order we assign to the domains we are speaking about.

Of course, the number 3 could have been given a different name (e.g. *trois*) but the question is whether a numeral could have a different semantic format given the notion of a numeral, i.e. arguably given the notion of an individual. Quantificationally, the number 3 may be defined as in (7), so there is a semantics involved which escapes an all too trivial formulation of the Saussurean axiom of conventionality. Nothing would prevent another sort of relation between the NP and VP. Yet, one may argue that the relation between the NP and the VP expressed as $[[_{NP}$ Det N] VP] receives a fixed interpretation on the basis of the configuration in Figure 1 which does not seem so incidental or arbitrary.[7]

THE LAW OF DISTRIBUTIVITY

Sentences like (9):

(9) $a.$ John, Sue and Mary ate four sandwiches
$b.$ Three children ate four sandwiches

strongly suggest that one may think about the NP VP relation in terms of a function giving to each of the members of the NP-denotation its own private VP, so to say. That is John ate four sandwiches, Sue ate four sandwiches and Mary ate four sandwiches. And due to the irreversible nature of eating this means that we are speaking about 12 sandwiches. These events may have occurred at the same time or at different times and places, but the main point is that (on this interpretation) each of the individuals of the subject NP have its own individual "path" expressed by the predicate. Now, this is reminiscent of, or even similar to what we are used in arithmetical operations like:

(10) $3 \times 4 = 12$

We know that (10) is equivalent to $(2\times4)+(1\times4)$ and to $(1\times4)+(1\times4)+(1 \times 4)$. This equivalence is known as the law of distributivity. It governs a class of mathematical operations among which the Boolean intersection in Figure 1 occurs. We break ⟦*John and Sue and Mary*⟧ × ⟦*Eat four sandwiches*⟧ down into ⟦*John*⟧ × ⟦*Eat four sandwiches*⟧ + ⟦*Sue*⟧ × ⟦*Eat four sandwiches*⟧ + ⟦*Mary*⟧ × ⟦*Eat four sandwiches*⟧.

The basic idea emerging here is that in offering the information conveyed by (9), the "lumpsum"-information expressed by their subject NP is automatically broken down into information concerning the basic elements constituting the sets {John, Sue, Mary} in (9a) or the set of three children in (9b). This is what the law of distributivity is about: it guarantees that no information given at the level of 3×4 is lost at a lower level of organization.

Given the crucial role played by the law of distributivity this is the point where semantic considerations come in:the level at which information expressed by language is organized interpretively seems to be determined by principles of computation presumably more basic than syntax itself. In fact, there are two things that should be explained away before (re-)assigning primacy to syntax. Firstly, one must explain why it is that a basic computational principle like the law of distributivity available to us as part of our linguistic abilities should determine syntax in such a fundamental way as to determine the NP VP structure. Secondly, and even more important: one should explain why it is that the law of distributivity is only applied asymmetrically. It works one way, so to say, because we can derive from (9) that there were 12 sandwiches involved but not that there were twelve children involved. But this can only mean that syntax serves as a constraint on what otherwise would be the full application of the distributivity principle. Syntax uses just one part of a more general principle and is in this way dependent on it.

Let me recapitulate from another point of view. Suppose that in a syntactic structure of the form $[\alpha \oplus \beta]$, with $\oplus$ a syntactic operation joining α and β into a group $\alpha\beta$, and suppose that $\alpha\beta$ is always of type α', which would mean that $\alpha\beta$ is always an α-phrase, much in the way a VP is a V-phrase. And suppose that we are able to interpret $\oplus$ as a function which is similar to or is structurally related to (a principle determining) an operation in one of our number systems. Assume furthermore that our cognitive organization heavily depends on our use of number systems (discretization of individuals, order, measurements, etc.), then the very fact that our syntax in natural language is tied up with this system may be explained as so closely tied up with semantics that one is obliged to think in terms of interaction rather than of primacy. With respect to (10) a plausible hypothesis is that our cognitive organization of the world forces us into the intersection relation $\cap$ because it mirrors certain features of our computing capacity in which distributivity takes its natural place.[8] Note that this does not mean the return of religion as the semantic fosterplace of rituals, because we are speaking about semantics at a very abstract level of cognitive organization. We are speaking about the semantics of our number systems involving our capacity to distinguish between individuals and mass and assume that these semantic principles cannot be abstracted from in the study of syntax, not even in the syntax of rituals.

NEGATION

How much syntax goes into (11)?

(11) John does not walk

The syntax of predicate logic tells us that *(does) not* is to be taken as an expression which, when applied to (1), yields the wellformed expression (11). But its semantics says that if (1) is true, (11) is not true. If (11) is true, (1) is not true: $[\![\neg\varphi]\!] = 1$ iff $[\![\varphi]\!] = 0$. Again the syntactic element bringing this about –*(does) not*–could have been different but the set-complement relation seems to be something which is brought about by the fact that we use a name for a constant, however arbitrarily, to split a domain. The very use of a name invokes the use of a splitting function characterizing the members of a set, and so inevitably there is the structuring of a domain and in this structuring semantic considerations must be given a place: any function having {1,0} as its co-domain can be said to produce negation as corresponding to a complement. There is syntax in this but the fact that we apply these functions systematically in our use of language reveals that beneath the superficial fact that their input could have been differently, there is the question of why we pick them out among so many different functions that could have been employed otherwise. The point is again: as soon as we are able to systematically relate certain expressions in a language to algebraic structure, we cannot maintain the strict distinction between syntax and semantics and subsequently the abandonment of semantics. The next step is: as soon as we need algebraic structure in order to explain our cognitive organization, it is very hard to maintain the Chomskyan claim about the study of natural language and hence Staal's claim about the syntax of ritual. The two claims are logically independent, so it might turn out that Chomsky's claim may be rejected and Staal's claim may be maintained, but given the fact that Staal stresses the connection, the point on negation may apply to him as well.

PLURALITY AND SINGULARITY

This line of thought may be applied to the relationship between the stem *child-* and its plural form *-en*. If we analyze the internal structure of the plural form *children*, we need interpretively something like (12):

(12) $a.\ \ I(\textit{child}-) = \mathrm{C} = \{x_e : x \text{ a child}\}$
$b.\ \ I(-\textit{en}) = pl = \{\langle x_{et}, y_{((et)t)}\rangle : y = \{z_{et} \subseteq x : |z| \geq 2\}$

In (12), x ranges over sets and y over the collections of sets having two members. So, (12b) applied to the set C says that pl takes C and yields the set of all sets formed out of C minus the emptyset and the singletons. This means that C, as proposed by Jespersen (1924), is taken to be neutral as to singularity and plurality and that sg can be taken as an instruction to structure the set C into a set consisting of all the sets containing one child and that pl is as shown in (12): the instruction to form a collection of sets of pairs, triples, etc. out of the members of the set C.

Suppose that this analysis can be defended (which means an adaptation of the model in Fig. 1 but not an essential one for the point made above), then again we see a division of a collection into two disjoint subsets.[9] And again we see that a fundamental semantic phenomenon is visible. In this case, there is an interesting fact:Japanese does not distinguish between singular and plural in the way English and many other languages do. So, rather than having (12b) and for sg the meaning $\{z_{et} \subseteq x : |z| = 1\}$, Japanese would have something like (13).

(13) $sg/pl = \{\langle x_{et}, y_{((et)t)}\rangle : y = \{z_{et} \subseteq x : |z| \geq 1\}$

This means that Japanese would neutral as to how the set C is structured. It does not mean that C is not structured. On the contrary the mechanism to produce all the subsets of a certain set is something that can be argued to be available also in Japanese. Note that the fact that Japanese has a different strategy from English enhances the present argument rather than weakening it. Languages are bound to develop different strategies. The Japanese case suggests that this is a selection from possible choices from algebraic options. A difference between 1:many vs neutral. So, again the question arising is: how much syntax is actually going into this analysis and how much semantics? If combinatorial principles of mathematics underlie the ordering of sets and their structuring into sets of sets meeting certain universal conditions, then it might be argued that some of these universal conditions could have to do with the way we structure the world. We organize an unorganized set of individuals into a domain full of structure about which we can speak, but it is doubtful whether it would be revealing to call these principles syntactic only, unless we can show that the structuring has nothing to do with our cognitive organization. One may, of course, call any form of cognitive organization syntactic, but this would make the debate about a syntactic or semantic approach of strings a terminological debate rather than a real issue.

CONCLUDING REMARKS

My contribution to this collection of papers is an appeal to those who want to carry on with the discussion, to pay some attention to factors that I have been pointing at. What I have said might or might not be relevant but this can only be assessed on the basis of taking Staal's claim seriously and exploring it further.

The three cases that I discussed as an illustration of my remarks on the relation between syntax and semantics have in common that all of them may be reduced to fundamental constraints on set theoretical structures. An important question is whether any syntax can escape from a set-theoretically based ordering giving away fundamentally cognitive modelling of the world as we perceive and cognize it. I do not want to push this point any further but I think that in the discussion about the relation between syntax and semantics, the issue of the structure of our cognition should be given a role. I accept without any problem the thesis that the proof-theoretical approach of generative linguistics, leading to the exclusion of semantic considerations, has been shown to be very fruitful for certain areas of language structure, though not all I should add. It has been shown to be fruitful for Staal's treatment of ritual, as far as I can judge, at least for a more profound discussion of the issues involved. But in linguistics it might turn out that in certain areas semantic considerations must interact with purely syntactic ones, certainly in view of computational principles in which the basic organization of our cognition is involved. I have tried to argue that with respect to formats as in Figure 1 these principles may be discovered, because basic patterns of predication may be related to principles determining our capacity to compute. An interesting consequence of our capacity to count, i.e. to distinguish entities, to keep measure, to make music, to dance, could be that all sorts of mathematical structure which is part of this capacity might be due to the fact that we relate our syntax to the world and get its structure back as meanings.

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Notes

[1] I refer here indirectly to the discussion in the generative framework that took place at the end of the sixties. Some proposed to take first order logic as the deep structure and they thought that they took semantics as primary. In fact, this turned out to be nothing but (an inferior sort of) syntax, because there was no genuine interpretation involved in the model-theoretic sense. Montague employs higher order techniques in order to overcome some of the shortcomings of first order languages and added the necessity to interpret expressions with respect to a model in which they are true or false.

[2] I restrict myself here to the interpretation of constants as they appear in natural languages and shall not pay attention to the assignment of values to variables. All members of traditional lexical categories are treated as constants.

[3] One of the things ignored in the claim of conventionality is that once the relation between a constant and its reference is made, it remains more or less fixed at the language side, apart from phonological changes to which morphemes of a language are subjected. In general, one could say that once they are paired there is a tendency to retain both the sound and the meaning as constant as possible. It opens up the question of whether the rigidity just mentioned is a fact of syntax or a semantic fact. I do not know how this point relates to Staal's discussion of rites that receive "ambiguous" intepretations, i.e. the aspersion and the fecundity interpretations (1989, p. 115 ff., in particular p. 128)

[4] I will not discuss tense, because this would not throw any light on the issue under discussion.

[5] I simplify here the treatment of conjunction to some degree: for the present purpose it suffices to show the relation between $[\![.]\!]$ and I

[6] The formula in (8) is often given in a functional form with so-called λ-abstraction. In the case of (4) this means that one can see *three* as a function taking the set C (x in (7)) and yielding a function that takes W (y in (7)) and has as its output the truth value 1 if and only if three individuals are both in C and W.

[7] This bears on the discussion about configurationality, as e.g. in Chomksy (1981). The question is whether or not all language can be put into the NP VP format even though they do not have in on the surface. I will not enter into this discussion here, but if one rejects the position that all language have the NP VP format (at least at a "deep structural" level, a reasonable position seems to be that non-configurational languages organize their predication into the format of Figure 1 with different linguistic means.

[8] $\cap$ in a Boolean algebra is here the counterpart of the $\times$ in arithmetics.

[9] A collection of sets is a set of sets, so if it splits up one obtains two sets of sets.