Jackendoff´s Semantic Structures

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Ray Jackendoff has developed a semantic theory which claims to be the semantic format corresponding to Transformational Grammar. As the syntactic rules the rules of sematics are implicitly known, and the basic structures are innate. This innateness of basic structures guarantees intersubjective reference. Each speaker refers only to his or her projected world, not to an objective world. He or she does so by using conceptual structures, which might be projected as entities of various kinds. This conceptual structure is the same in cognitive capacities as vision and the use of language. Concerning human categorization Jackendoff argues against other theories of meaning, especially theories of truth conditions (§1). Furthermore the semantic structures should obey a grammaticality constraint which is violated by the predicate calculus (§2). The thematic relations hypothesis (§3) concerns the underlying structure of all sematic fields.

§1 Human categorisation, features, and word meaning

The problem of human categorisation concerns the human ability to subsume particulars under types. This subsumption is typically expressed by a predicative sentence "a is F". Categorisation is not restricted to humans. An animal can discriminate objects as belonging to the type of eatable things or as not eatable. Since the animal does not use human language categorisation does not dependent on human language. It involves cognitive capacities like vision. Although categorisation takes place not only in the use of language, the study of meaning will focus on categorisation by the use of meaningful symbols. The most general question concerning symbolic categorisation is: How do we understand atomic sentences? Seeing Lisa we have a representation of Lisa. If somebody says "Lisa is a cat" there has to be some fit between the representation of Lisa and the representation of what it is to be a cat, i.e. belong to the category *cat*. The category of cats is represented by our concept of cats. The sentence is the result of some cognitive operation of comparing two items of conceptual structure. Lisa is represented as an individual thing, i.e., by a [TOKEN] concept, and the category of cats by a [TYPE] concept[1]. Corresponding to the ontological categories of particulars, there are [THING TOKEN], [EVENT TOKEN], [PLACE TOKEN] etc. Accordingly there are [THING TYPE], [EVENT TYPE], [PLACE TYPE] etc. Resembling the predicate calculus a atomic sentence concerning the fact that the representation LISA of Lisa is classified as conforming to the conceptual structure CAT can now be represented as

[1]) Conceptual structures are indicated by the use of bold letters. The conceptual structures are universal. The naming of an universal conceptual structure by the name "GO" for example does not exclude to name it "GEHEN" in a German textbook. The named conceptual structure is the same feature, which is part of the meaning of verbs of motion in both languages respectively.

[THING TYPE ([THING TOKEN])]
CAT   LISA

But what is the conceptual status of this composition of [THING TYPE] and [THING TOKEN]? And since "cat" is a NP in syntactic structure a representation in which the two NPs are arguments of a function "is an instance of" is more appropriate:

[STATE TOKEN   ([THING TOKEN], [THING TYPE])]
IS AN INSTANCE OF   LISA   CAT

The function "IS AN INSTANCE OF", part of our conceptual structure, maps the [TOKEN] and the [TYPE] into a [STATE] (cf. Jackendoff 1993: 79f.). In this representation the two NPs as maximal projections refer to ontological categories, although [TYPE]s are projected only through their instances, and the sentence as a maximal projection refers to a state (see §2).

This mapping uses the internal conceptual structure of [TYPE]s and [TOKEN]s. The elements of these structures are the conceptual features, e.g. FOUR-LEGGED might be a feature entailed in the conceptual structure CAT. Since Lisa is seen as being a four-legged animal the representation of Lisa fits in this respect the conceptual structure of the type CAT. Features have to be abstract for the following reason. If the number of tokens were finite and the tokens were known to the language user, the internal structure of a [TYPE] could consist in a list of all the members of the corresponding category. But we encounter new particulars in our experience and we are able to identify them as belonging to a specific [TYPE]. That is: our categorisation is creative. We may never have seen Lisa before but at the spot of seeing her we identify Lisa as CAT. We are also able to create new [TYPE]s. Taking the representation of Lisa´s colour as a prototype we can invent the [TYPE] of LISA-BROWN. This is only possible if the representation of Lisa is structured in a fashion that is useful as a structure of a [TYPE]. Creativity, therefore, is further evidence for the structural isomorphy between [TOKEN]s and [TYPE]s. Since [TYPE]s can be created a [TOKEN] cannot be a list of all the [TYPE]s it exemplifies, too. That [TOKEN]s and [TYPE]s of a given ontological category are expressed by the same syntactic category gives grammatical evidence to this assumption (cf. Jackendoff 1993: 88ff.).

If the content of a [TYPE] cannot consist in a list, it has to consists in a set of rules which can be employed in new situations. These rules need not be accessible to our awareness. They specify the features of e.g. CAT. The feature FOUR-LEGGED says: If x is a (healthy) cat, it has to have four legs. This rules states only a necessary condition. Not all four-legged creatures are cats. To classify x as a cat we need further evidence, i.e. further features have to fit. And four-leggedness might even not be necessary, as the qualification indicated. Lisa might have lost a leg in an accident. But she still is a cat. So only the typical, i.e. healthy, cat is four-legged. In general the content of a [TYPE] cannot be specified in necessary and sufficient features. Wittgenstein´s famous example is the [TYPE] GAME: are there any necessary and sufficient features that are all fulfilled by all games? No, there are not! Even WINNING/LOSING is not universal for games: for example you cannot win a Patience. WINNING/LOSING may be typical of games, but typicality conditions are different from necessary and sufficient conditions. They allow for exceptions. A typicality rule may state: The typical game involves at least two parties one of which does win the game. Patience is one of the exceptions to this typicality rule. Patience still counts as GAME, since it fulfils some other features of GAME like being a spare time activity done for no other purpose than having a good time (- assuming these to be features of GAME). If we just know that some behaviour is a game, we assume that is has the typical features of GAME. So we might look for the at least two parties involved and the rules which they follow in their attempt to win. That is, we use the typicality conditions as default values to supplement missing information on the item in question. In this function typicality conditions differ decisively from necessary and sufficient conditions. And not even all necessary and sufficient features come in a yes/no-pattern. Judging from appearance alone we may be unsure whether some kind of lemur is a cat. Being four-legged, furry, having a long tail, jumping on trees it resembles our picture of being a cat. It might even resemble our representation of a prototypical CAT more closely than a well-fed Carthusian cat. The more a [TOKEN] deviates from the centrality conditions of a [TYPE] the more likely we will judge a categorisation as "not sure". The information entailed in the conceptual structure associated with a [TYPE], which is the meaning of a [TYPE] expression like "cat", contains, therefore, necessary conditions (a cat is at least a THING), graded conditions which specify a central value for a continuously variable attribute, and typicality conditions that allow for exceptions (like the one mentioned in the case of GAME). This rule-system is the meaning of a [TYPE] expression. The rules work together in the following fashion: If a [TOKEN] of the appropriate ontological category satisfies all necessary conditions of the [TYPE] its fitting one of the sufficient conditions or being close enough to the prototype yields the categorisation; then all default values not contradicting the [TOKEN] representation are inferred by the typicality conditions. If Lisa is not only a THING and ANIMATE but also a four-legged, furry, purring creature which looks like the prototypical European domestic cat we say "Lisa is a cat", and we infer that Lisa will chase the mice out of our kitchen, since this is what European domestic cats typically do. If a [TOKEN] x fits the necessary features in a [TYPE] but fits the three typicality conditions only to some degree, we calculate the result from the degree of fitting conditions α, β, γ and the importance of conditions α, β, γ. x has to meet some "measure of stability" (Jackendoff 1993:140) to count as belonging to the [TYPE]. Our judgement will be graded accordingly. Categorisations are not simply "true".

To fulfil the requirements imposed on an account of linguistic categorisation by the facts of creativity and gradedness word meaning has to be represented as a system of preference rules.

Word meaning contains structural description (e.g., the movements of the rook in chess) and perceptual information (e.g., a representation of a typical knight) in centrality conditions. Word meaning can be decomposed in features which are part of our conceptual knowledge.[2]

§2 X-bar syntax, ontological categories, and the problem of the VP

Sentences are not lists of words. They are structured because of the structural properties of their constituents. Which parts of a sentence form a sentence part, a "phrase", can be seen, for example, in questions. Concerning the sentences "The cat caught the mouse in the house." we can ask "Who caught the mouse?". The answer is "the cat". The "the" goes with the "cat". "The cat" is a noun phrase (NP). If we ask "What was it that the cat did?" the answer is "Catching the mouse in the house was what the cat did." "caught the mouse in the house" is, therefore another phrase, the verbal phrase (VP). Within it "in the house" is an independent phrase itself, since it answers the question "Where did the cat caught the mouse?". This is a prepositional phrase (PP). Each phrase is a projection from the head of the phrase. Each lexical category projects to a phrasal category. The head gives the phrase its specific character: A noun is the head of a noun phrase, a verb is the head of a verbal phrase, and so on. The lexical entry of a word contains information about the argument structure of the word. "catch" for example requires an object which is caught. Since objects are expressed by noun phrases, "catch" should be followed by a noun phrase. This relationship is called subcategorisation, the verb "catch" subcategorises a NP. Subcategorisation determines the syntactic environment of the head. This subcategorised NP of "catch" is the "complement" or "argument" of the verb (cf. Sells 1985: 28). The combination of head and argument is a first projection of the head. No further phrase can be inserted between the head and its complement without generating an ungrammatical sentence. But further specifications of the catching are possible. Since they are not necessary by the meaning of "catch" such specifiers, which precede the head, or modifiers, which follow the head, are optional. "in the house" is such a modifier (or "adjunct"). The first projection connected to the modifier gives the second projection. Since there are only arguments, which are necessary, and specifiers or modifiers, which are optional, this second projection is the maximal projection of the head. If the head is of the syntactical category X, the first projection is X' the second projection is X" (or XP). Because of this notation this analysis is called "X'- Theory". Leaving the argument and the modifier as a whole phrase we have in our example:

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[2]) The most basic of them are probably innate and serve as basis in the "syntax of semantics"(see §3). [TYPE]s in contrast are abstractions from [TOKEN]s, which are learned by ostensive definitions and depend for their organisation on a specific language.

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                 V"                (maximal projection)
               /        \
             V'          P"        (P" as a modifier)
           /    \
         V       N"                (N" as an argument)
         |
    caught  the mouse    in the house
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We can draw a general tree diagram of the phrasal structure:

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                X"                      (maximal projection)
          /     |          \
    Specifier     X'          Modifier
                /    \
              X     Argument
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The head X and its argument are "sisters", since they share the node which is directly above them. Specifier and modifiers are never sisters of a head, since they are added at the X'-level. This is true even when a head has no complement. Since we assume that all phrases have the same basis structure, there has to be a X' in the tree (e.g., above the head "Lisa" as the head of a NP).

Jackendoff aims at a semantics that does not violate the grammatical constraint which says that the syntax of a language is linked to its meaning system in such a fashion that syntactic differences and generalisations are semantically important. The learner of a language "must be independently guessing the meaning of utterances from context and putting it to use in determining syntax" (Jackendoff 1993:13). The semantic theory, on the other hand, will use syntactic generalisation as a hint to parallel semantic generalisations (cf. Jackendoff 1993: 57). A representation of meaning by the use of the predicate calculus will violate this constraint. In natural languages we need constants not only for NPs but also for PPs, VPs etc. The predicate calculus is most inappropriate in its treatment of prepositional phrases and adverbial modification (of events). So Jackendoff takes as his point of departure X'-syntax. The independent units within a sentence, which can be the objects of questions or anaphoric reference, are the phrases (i.e. the maximal projections). Jackendoff links reference as a key notion of semantics to the maximal projections: each maximal (syntactic) projection is semantically projected into a referent of the ontological category which is determined by the semantics of the head of the maximal projection.[3] The lexical heads of maximal projections correspond to functions in semantic structure. The head subcategorises arguments in syntax, the corresponding semantical function takes arguments to compute a semantic value. If the argument places of a semantic function are filled by the readings of the maximal projections which are subcategorised by the head, we have a correspondence between syntactical and semantical structures.[4] The semantic value of a conceptual structure is a projected instance of one of the ontological categories. Since X'-syntax is assumed to be universal, the ontological categories are universal as well. In our example the maximal projection "the cat" is projected into an [THING], "in the house" is projected into a [PLACE], since the head of the PP ("in") is a place function in semantics. Other ontological categories are [PATH], [EVENT], [STATE], [ACTION]. With [ACTION] a problem arises in Jackendoff´s analysis. Whereas the current theory of X'-syntax (Government-Binding Theory) uses a X" as a maximal projection (cf. Radford 1988), Jackendoff uses a X"' as a maximal projection (cf. Jackendoff 1993: 64ff.). Furthermore Jackendoff takes the verb as the head of the sentence. This second thesis leaves no place for an ontological category [ACTION]: The sentence, which is in Jackendoff´s analysis the maximal projection of the verb, projects into a [STATE] or into an [EVENT]. Jackendoff´s analysis of "The cat caught the mouse" would be:

[EVENT ([THING], [THING])]
CAUGHT CAT MOUSE

There is no VP as a maximal projection. Therefore there is nothing [ACTION]s could be projected from. But there should be [ACTION]s. Actions are part of our picture of the world. And there is syntactic evidence for an ontological category [ACTION]. With respect to "The cat caught the mouse" we can form the pseudo cleft "What the cat did was catching the mouse". Here we have an actor ("the cat") and an action ("catching the mouse"). This is syntactic evidence that there is a maximal projection. To have an ontological category [ACTION] Jackendoff defines [ACTION] as [EVENT] with one argument missing. In this analysis the actor is moved out. Since we still need a maximal projection - only maximal projections refer -, the actor has to leave a variable behind, i.e. the actor is moved out to make it possible to have a maximal projection beneath the sentence level, and the actor is still there to have a maximal projection which can project into [ACTION]. The example will be analysed:

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3) The only exception to this referentiality principle are phrases that express [TYPE] constituents (cf. Jackendoff 1993: 94). [TYPE]s do not correspond directly to experience. We experience a [TYPE] only through its [TOKEN]s which are projected.

4) This correspondence will become problematic in more complex syntactic structures and with semantic representations which deviate considerably from surface syntax (cf. Part III of Jackendoff 1993b). To start with, there is no one to one correspondence of syntactic and ontological categories in English.

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[THING    ]i  [ACTION  ([THING]i, [THING    ])]
 CAT          CAUGHT               MOUSE
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The "i" binds the variable to the actor that was moved out. But now we have no function that maps these two arguments into an event. This can be done in the Government-Binding analysis. The head of the sentence in this analysis is the inflection. The sentence is an inflectional phrase. The inflection subcategorises the VP, which is now a maximal projection. The general tree diagram is (Radford 1988: 510):

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            I"
          /     \
       NP        I'
               /     \
              I       VP
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Now we need no "actor movement". The GB-analysis of the example is:

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[EVENT ([THING     ], [ACTION  ([THING     ])])]
   I        CAT          CATCH      MOUSE
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Inflection serves as a functional head, in opposition to lexical heads.[5] The sentence is a phrase, but its head is a functional category. With the GB-analysis Jackendoff´s referentiality principle can be extended to verbal phrases without the introduction of an otherwise ad hoc movement rule.[6]

§3 The thematic relations hypothesis and the question of a "syntax of semantics"

Jackendoff sees the semantics of motion and location as a key to a couple of other semantic fields. This assumption is the thematic relations hypothesis: in any semantic field of [EVENT]s and [STATE]s the principal conceptual functions are a subset of those used for the analysis of spatial motion ([EVENT]s) and location ([STATE]s); fields differ in (i) what sort of entities appear as theme (i.e., occupy the semantic role whose movement or position is indicated by the sentence of motion or location), (ii) what sorts of entities may appear as reference objects (e.g., [THING]s which specify the goal of the motion), and (iii) what kinds

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[5]) Wh-questions and embedded sentences point to the existence of a CP (complementizer phrase) above the IP. Complementizer is another functional head (cf. Radford 1988: 512). Functional heads can be empty.

[6]) Here the GB-analysis has been carried out for [EVENT]s. Sentences projecting into [STATE]s, typically using "to be", will be analysed with "be" as the inflection for [STATE]s. There is no [ACTION] corresponding to the VP in such a sentence. This can be seen by the failure of the pseudo cleft construction: *"What the cat is is be brown". "being" is no action.

or relations assume the role played by location in the field of spatial expressions (e.g., possession as location at a [THING]) (cf. Jackendoff 1993: 188). The basis of this thesis is the analysis of the field of spatial expressions. The conceptual functions are abstracted from the verbs involved. These are related to the ontological categories of [PLACE] and [PATH], which are expressed by prepositional phrases. A place function maps a [THING], being the reference object of the place specification, into a [PLACE], for example:

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[PLACE     PLACE-FUNCTION ([THING   ]) ]
 IN                        HOUSE
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[PLACE]s project to a point or region. A [PLACE] is normally occupied by a [THING]. An [EVENT] or a [STATE] might be placed in a location. [PATH]s have more varied structure, i.e., might be specified relative to a [PLACE]; a [PATH] might be traversed by a [THING], or a [THING] (like a motorway) might extend over a [PATH] or a [THING] (like a signpost) might be oriented along a [PATH] (cf. Jackendoff 1993: 163ff.). Using these conceptual structures we can analyse a sentence like "Bert is at school." As

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[STATE     ([THING], [PLACE ([THING     ])])]
  BE         BERT     AT     SCHOOL
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"BE", "ORIENT" and "GO_{EXT}" (in a sentence like "The road goes from Cologne to Munich.") are the feature expressing [STATE]s in the spatial field. "AT" expresses spatial location. "GO" and "STAY" are the feature expressing [EVENT]s in the spatial field. "GO" is a feature that all verbs of motion, which are decomposed into features in this analysis, have in common. "Bert went to school" is analysed:

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[EVENT     ([THING], [PATH  ([THING     ])])]
  GO         BERT     TO     SCHOOL
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According to the thematic relations hypothesis the features defining the verbs of motion and location and the [PLACE]- and [PATH]-functions can be used in the analysis of other semantic fields. The features are marked by an index to exhibit this modification (e.g., "AT_{POSS}" for being at a [THING] in a possessive sense). The semantic field of time uses the same prepositions. Sentences concerning time have attached PPs in the same way sentences of location have. Compare: "Bert is at school." to "Maths it at 11:30." In the temporal field we have [STATE]s and [EVENT]s, [EVENT]s and [STATE]s are themes, [TIME]s are the reference objects (i.e., the maximal projection PP maps also into the ontological category [TIME]), and time of occurrence plays the role of location in the spatial field.[7] So we have:

[STATE ([EVENT], [PLACE ([TIME])]]
E_{TEMP} MATHS AT_{TEMP} 11:30

The same can be done with the semantic field of alienable possessions. Possession plays the same role as spatial location. [THING]s appear as theme and reference objects. A sentence "Bert received the pencil." projecting into an [EVENT] is analysed:

[EVENT ([THING], [PATH ([THING])])]
GO_{POSS} PENCIL TO_{POSS} BERT

The more the analysis is extended to semantic fields in which the parallel is less obvious the more the underlying semantic structure will deviate from the English surface structure. Jackendoff´s syntax of semantics resembles the predicate calculus. Talking about the way meaning is structured gives a formalism which violates the syntactic constraint to get generalised representations of meaning. English syntax is just the syntax of English not of semantics.

In contrast to Lakoff (1987) Jackendoff does not see the thematic relations hypothesis as a thesis concerning a metaphorical mapping from the field of spatial expressions to other fields. Instead he assumes that all semantic fields are organised in parallel. This is not metaphorical since there is no other type of organisation available. To speak of a metaphor we need such an other type to contrast the literal organisation with the metaphorical organisation. If no such type is available there was no metaphorical mapping on an otherwise well defined structure in the first place. The organisation of semantic fields, therefore, is an underlying, probably innate, structure. The field of spatial expressions is basic only in learning and because of its reinforcement by the senses.

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[7]) Cf. the conditions laid down in the thematic relations hypothesis.