What is zone theory?

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要　旨

依存文法が苦手なのは特に語順を説明することである。なぜならば，依存文法の要素は単語なので，単語以上の要素を想像しないから，語順のような抽象的な現象は記述できないのである。しかし，語順の記述は望ましいであろうと思っている。本論文では，依存文法の専門用語から，語順が記述できる術語を定義して，言語のデータに適用してみる。

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DEPENDENCY THEORY

Dependency theory is the name for a syntactic formalism that centers on hierarchical, i.e. antisymmetric relationships between syntactic constituents. Syntactic constituents can be *words* or *phrases*. This is not the place to lead an appropriate discussion, but it is possible to convincingly show that within a dependency theoretical framework phrases cannot be defined prior to words, and thus are not basic. Basic syntactic constituents in a dependency theory are always words—an assumption that is corroborated by the fact that most writing systems use a symbol to separate words. This symbol usually has no physical form, but can

be created on a keyboard by pressing the *space* key. There are exceptions like Chinese and Japanese, for example, but there is no known writing system that uses a symbol to unify or separate phrases.

Depending on a given language, words themselves may not be simplex but consist of analyzable parts, called *morphs*. Whether morphs can, may, or must be abstracted to *morphemes* is a matter that is being discussed currently, but that matter is not yet decided. Personally, I believe there are good arguments in favor of the assumption of morphemes, and I also think that there are very good economic reasons to apply the notion of morphemes to descriptions such as valency theory. However, it is not essential to the understanding of this paper to assume the existence of morphemes. I have therefore taken to a unified notation "*morph(eme)*" in order to give any reader the possibility to follow the technical proposal outlined below.

It does not matter either whether words are simplex or complex because a simplex word constitutes a morph(eme) by itself. The expression "morph(eme)" is a global expression that comprises at least three different notions: i) a certain amount of semantic information, ii) a certain amount of formal information, and iii) a certain amount of physical information. Semantic information can come in different layers. For example, the English flexeme *–s* for [3.sg.] also expresses "present tense", but it expresses it differently than the expression *present tense*. In *present tense*, "present tense" is the meaning of *present tense*, but "present tense" in [3.sg.] *–s* is not a meaning, but a grammatical function that extends to the verb to which *–s* is assigned. Meanings are also called *sememes*. Besides sememes and grammatical functions, there are features. There are semantic features and grammatical features. For example, a semantic feature of *present tense* is [-CON(crete)], i.e. *present tense* is not a word that designates a physical object. Furthermore, *present tense* contains the grammatical feature [sg], because it always takes singular form without pluralizing affixes. Semantic features are also called *semes*, and grammatical features are called *grammemes*. Sememes, functions, semes and grammemes are summarized by the term *semanteme*.

Formal information can be highly stratified. While *present tense* is a compound noun, *–s* is a flexeme. Distinguishing between nouns and flexemes is an important business, because on the object level of languages nouns cannot occur in places where flexemes usually occur. The difference in morphological classes such as noun or flexeme is expressed by *classemes*. Thus, *present tense* carries the classeme [N'] (for compound noun), and *–s* carries the

classeme [+f] (for flexeme).
Physical information is any information on the phonology of a morph(eme). Thereby, a morph(eme) is expressed as an array of *phonemes*. However, this property is not essential to the topic I address here.
Semantemes and classemes of different morph(eme)s of different words can interact, and for all practical purposes do so constantly in sentence structuring. Although I am presently not able to provide a detailed statistical account, experience indicates that in the overwhelming majority this interaction between semantemes and classemes is logically antisymmetric. But there are exceptions that shall be utilized later in this paper.
Depending on whether it is a semanteme or a classeme that is affected by the interaction between two morph(eme)s, there are two different, general types of interaction: i) *selection*, and ii) *control*.

(D-1) A morph(eme) N *selects* the semanteme S of another morph(eme) M
iff the admissibility of M to cooccur with N hinges on M having S as a semanteme.
(Ex-1) red books

The morph(eme) *book* carries the seme [+CON] because it designates a physical object. Physical objects must have color (even black holes are black!), therefore *red* fits the admission criterion, because its semanteme "red" is a color.

(D-2) A morph(eme) N *controls* the classeme C of another morph(eme) M
iff the admissibility of M to cooccur with N hinges on M belonging to a certain morph(eme)-class C.
(Ex-2) red books

The morph(eme) *book* carries the classeme [N], and this classeme admits the occurrence of other morph(eme)s with the classeme [A]. Since *red* is an adjective, it is controlled.

The difference between selection and control is very important at a specific level of morphosyntax. However, as soon a more general description is desired, terminological economy dictates a unifying concept. This concept will be called *proto-dependency*.

(D-3)　A morph(eme) M is *proto-dependent* on another morph(eme) N
iff N selects or controls M.
(Ex-3)　red books

The morph(eme) *book* selects the color feature of *red*, and controls the classeme [A] of *red*. Therefore, *red* is proto-dependent on *book*.
Proto-dependency is still a relationship between morph(eme)s. Syntactic description, however, demands a relationship between syntactic constituents—which in a dependency theory are *words*. Words are defined differently in different languages. In the most general way, a word must at least consist of one morph(eme) which itself carries a lexical classeme. A *lexical* classeme designates a morph(eme)-class whose member can occur *without* other morph(eme)s. This may sound like a circular definition, but for that purpose, *affixes* are defined prior to *lexemes*.
Given that the notion of word is established, a first type of hierarchical interaction between words can be defined by proto-dependency. It is called *direct* or *immediate government*:

(D-4)　A word W *immediately governs* another word X
iff a morph(eme) N of X is proto-dependent on a morp(eme) M of W.
(Ex-4)　red books

Because *red* is proto-dependent on *book*, the word *books* immediately governs the word *red*. The converse term to direct government is *direct* or *immediate successor*. Successor terminology is crucial for special types of definitions that are required later on.

(D-5)　A word W is an *immediate successor* of another word V
iff V immediately governs W.
(Ex-5)　red books

Because *books* immediately governs *red*, *red* is an immediate successor of *books*.
Immediate government and its conversion, immediate successor, are the basic relationships of a dependency syntax. However, for holistic purposes and for inferring general and abstract statements from syntactic information, the above terms themselves are not general enough. A dependency syntax would most definitely work without any further terms, but it

would be very troublesome to define properties only with the concept of immediate government. It would be like trying to talk about a long line of ancestors only with the terms *parent* and *child*. In order to make a dependency more terminologically intuitive, further terms are necessary.
Such a further term is *indirect government*, a relationship between two words that are not in a immediate government relationship.

(D-6) A word W *indirectly governs* another word Y
iff W immediately governs a word X which immediately governs Y.
(Ex-6) astonishingly red books

Since *books* immediately governs *red*, and because *red* immediately governs *astonishingly* by control of the adverbal suffix *–ly*, *books* indirectly governs *astonishingly*.
As much as it was desirable to unify selection and control to proto-dependency, immediate and indirect government should be unified to *general government*:

(D-7) A word W *generally governs* another word X
iff W either immediately governs or indirectly governs X.
(Ex-7) astonishingly red books

Since *books* immediately governs *red*, and indirectly governs *astonishingly*, *books* generally governs *red* and *astonishingly*.
For later definitions, the completion of the successor definition thread is very important. However, instead of creating a converse term to indirect government, *indirect successor* shall have a much broader range. I shall achieve this by using a *recursive* definition. In a recursive definition, one part of the definiens (the defining part of a definition) is equivalent to the definiendum (the defined part of a definition). It is required, however, that the *last* verification step of a recursive definition ends with a part of the definiens that is different from the definiendum.

(D-8) A word W is an *indirect successor* of another word V
iff V indirectly governs W, or
if there is another word X which is an *indirect successor* of V,

and X generally governs W.

(Ex-8)　She has bought astonishingly red books.

The word *book* is an indirect successor of the finite verb *has* because *has* indirectly governs *book*. But the words *astonishingly* and *red* are also indirect successors of *has* because *books* generally governs both *astonishingly* and *red*, and *books* is an indirect successor of *has*. *books* immediately governs *red*, and indirectly governs *astonishingly*.
Immediate and indirect successor relationships are unified as *general successor*:

(D-9)　A word W is a *general successor* of another word V
iff W is either an immediate successor of V, or W is an indirect successor V.

The notion of general successor is required to define the important term *phrase*.

(D-10)　A series of words $W^1,...,W^n$ is a *phrase*
iff there is a word W^w, and
if all other words $W^1,...,W^v$, $W^x,...,W^n$ are general successors of W^w.

(Ex-10)　astonishingly red books

The series *astonishingly red books* is a phrase because *astonishingly* and *red* are general successors of *books*. In a phrase, the word of which all other words are general successors plays a crucial role, and it is called the *head*.

(D-11)　A word W is the *head* of a phrase P
iff all other words $V^1,...,V^n$ in P are general successors of W.

(Ex-11)　astonishingly red books

The word *books* is the head of the phrase *astonishingly red books*.
Once there are phrases, it becomes necessary to define hierarchical relationships for phrases. Government and successor relationships only allowed words as appropriate relata. Hierarchical relationships for phrases are called *dependency* relationships, and they are valid between a word and one or more phrases.

(D-12) A phrase P *immediately depends* on a word W
iff W immediately governs the head H of P.
(Ex-12) She bought red books.

red books is a phrase with the head *books. books* is immediately governed by *bought*, thus *red books* is immediately dependent on *bought*. If the head of a phrase P is an indirect successor of another word W, then P is *indirectly dependent* on W.

(D-13) A phrase P *indirectly depends* on a word W
iff the head H of P is an indirect successor of W.
(Ex-13) She bought books in a bookshop.

in a bookshop is a phrase which is directly dependent on *bought. a bookshop* is also a phrase, but its head *bookshop* is an indirect successor of *bought*. Therefore, *a bookshop* is indirectly dependent on *bought*.
Immediate and indirect dependencies are unified as *general dependencies*:

(D-14) A phrase P *generally depends* on a word W
iff P immediately depends on W, or if P indirectly depends on W.

Having defined the proto-dependency relationship, the government relationships, the successor relationships, and the dependency relationships, in a next step *zone theory* becomes accessible.

ZONE THEORY

The central idea of zone theory is the notion that word order is a mechanism by which major syntactic constituents are located according to specific properties that are expressed by the internal structure of the head. Word order change—or scrambling—is the result of relocating a constituent with reference to its prior location. Until now a theory that deals with scrambling in a systematic way without compromising central issues of the dependency notion, has not been provided within the dependency grammar community.
The zone theory proposed below tries to tackle the problems of basic word order and

scrambling while staying within the terminological borders of dependency theory, but the price is high: the reader should expect some very difficult formalizations.

As outlined briefly above, zone theory assumes that syntactic constituents are located according to the internal structure of the major—or finite—head. Finite heads are for all practical purposes always verbs, and the internal structure of verbs is very rigid—in every language. For instance, in German verb lexemes always precede suffixes which in turn always precede flexemes. The same is true for Japanese. In German—a language that contains numerus flexemes—tense suffixes always precede numerus flexemes. Since lexemes, tense suffixes, and numerus flexemes are expressed by distinct morph(eme)s, basic word order can be derived by determining which of these morph(eme)s interacts with which major syntactic constituents. The starting point for zone theory is thus the definition of a *head-structure*:

(D-15) The *head-structure* of a head H is the serial order of morph(eme)s M^{1-n} in H.

(Ex-15) kauf.t.e
buy+[past tense]+[–2 sg.]

The above-mentioned major syntactic constituents are more precisely defined as *primary constituents*:

(D-16) A phrase P is a *primary constituent* of a word W
iff P is immediately dependent on W.

(Ex-16) Das Mädchen kaufte gestern ein Buch in einem Buchladen.
“The girl bought a book in a bookshop yesterday.”

The phrases *das Mädchen*, *ein Buch*, *gestern*, and *in einem Buchladen* are primary constituents because they are immediately dependent on the head *kaufte*. The analogue is true for the English sentence. In a next step a hierarchical relationship between a morph(eme) of a head and a primary constituent is defined:

(D-17) A morph(eme) M of a word W *zone-commands* a phrase P
iff a morph(eme) N of the head H of P is proto-dependent on M,
and P is a primary constituent of W.

(Ex-17) Das Mädchen kaufte gestern ein Buch in einem Buchladen.
"The girl bought a book in a bookshop yesterday."

As (Ex-15) shows, the head *kauf.t.e* consists of three morph(eme)s: the verb stem *kauf*, the tense suffix *–t*, and the flexeme *+e*. The noun *book* is selected, and the preposition *in* is controlled by the verb stem *kauf*. Therefore the heads *Buch* and *in* are proto-dependent on the verb stem *kauf*. The adverb *gestern*, however, is proto-dependent on the tense suffix *–t*. Therefore, there are two different zone-command relationships.
Primary constituents that are zone-commanded by the same morph(eme) in the head-structure, are considered as located in the same *zone*:

(D-18) Two primary constituents P_1 and P_2 are located in the same *zone* Z
iff a morph(eme) M zone-commands both P_1 and P_2.
(Ex-18) Das Mädchen kaufte ein Buch in einem Buchladen.
"The girl bought a book in a bookshop."

The primary constituents *ein Buch* and *in einem Buchladen* are zone-commanded by the same morph(eme) of the head-structure, *kauf*. Therefore, they are located in the same zone.
If two primary constituents are located in the same zone, then they are located at different *loci* (sg. *locus*)

(D-19) Two primary constituents P_1 and P_2 are located in different *loci*
iff P_1 and P_2 are located in the same zone.

Therefore, the primary constituents *ein Buch* and *in einem Buchladen* are located on different loci in the same zone.
Two major zone types must be distinguished: i) *remote* zone, and ii) *close* zone. The notion of *remote zone* is somewhat difficult to grasp, but it is one of the most central concepts of zone theory. Primary constituents are zone-commanded by morph(eme)s of the head-structure. This means that morph(eme)s of the heads of primary constituents are proto-dependent on morph(eme)s in the head-structure. If primary constituents are located in different zones, they must be zone-commanded by different morph(eme)s of the head-structure. Proto-dependency, and thus also zone-command, are hierarchical

relationships. Sometimes, however, proto-dependency relationships hold for any configuration of their relata. This is commonly called "agreement" in linguistics. Primary constituents are considered as located in the *remote zone* if the proto-dependency relationship that justifies the assumption of a zone-command relationship runs both ways:

(D-20) A primary constituent P is located in a *remote zone* RZ
iff a morph(eme) N of the head H of P is proto-dependent on a morph(eme) M in the head-structure,
and M is proto-dependent on N,
even if N is also proto-dependent on another morph(eme) X in the head-structure.

(Ex-20) A good girl reads many books.

The noun *girl* in the primary constituent *a good girl* contains a grammeme [3.sg], and the same grammeme is also contained in the flexeme *–s* of the head. It is difficult to decide on the specific hierarchy in this and similar cases. The flexeme *–s* could as much be proto-dependent on the grammeme [3.sg] of the noun *girl* as vice versa. Therefore, the definiens of (D-20) holds, and *the girl* must be located in the remote zone. The other primary constituent *many books* must not be located in a remote zone, because there is not relationship whatsoever between any morph(eme)s in *many books* and *–s*. Primary constituents that are not located in a remote zone, are located by default in a *close zone*.

(D-21) A primary constituent P is located in a *close zone* CZ
iff the conditions for a remote zone do not hold.

(Ex-21) A good girl reads many books.

The primary constituent *many books* is located in a *close zone*.

Zone-command relationships instantiate *localizations*, i.e. they assign a specific localization to primary constituents. There are six possible localization structures for two primary constituents and their head:

(S-1) $P^1\ P^2\ [M^1\text{-}M^2]$

(S-2) $[M^1\text{-}M^2]\ P^1\ P^2$

(S-3) $P^2\ P^1\ [M^1\text{-}M^2]$

(S-4) $[M^1\text{-}M^2]\ P^2\ P^1$

(S-5) $P^1\ [M^1\text{-}M^2]\ P^2$

(S-6) $P^2\ [M^1\text{-}M^2]\ P^1$

In (S1-4), the head is on the periphery, in (S-5) and (S-6) it is not. It is also possible to say that the primary constituents are on the periphery in (S-5) and (S-6). In (S-1), (S-2), and (S-5) the order of the primary constituents P is equivalent to their zone-commanding morph(eme)s in the head-structure; i.e. the order of the primary constituents *echoes* the order of their zone-commanding morph(eme)s. In (S-3), (S-4), and (S-6), the order of the primary constituents does not echo the order of their zone-commanding morph(eme)s; the order of the primary constituents *mirrors* the order of their zone-commanding morph(eme)s. (S-5) is a compound structure in which the primary constituents are on the periphery *and* echo the order of their zone-commanding morph(eme)s. (S-6) is also a compound structure, because the primary constituents are on the periphery, *and* they mirror the order of their zone-commanding morph(eme)s.

Thus, three different localization types can be distinguished: i) *peripheral*, ii) *echo-*, and iii) *mirror-localization*. Peripheral localization requires the further terms of *smallest linear index* and *greatest linear index*. A *linear index* is an integer assigned to a word in a sentence. If a word is the first word in the sentence, the word receives {1} as linear index; if it is the second word, it receives {2} etc. The *smallest linear index* is that linear index that has the smallest value in a sentence, and conversely the *greatest linear index* is the one that has the greatest value in a sentence.

(D-22) A primary constituent P_x is *peripherally localized* in a structure S
iff the word with the smallest linear index in P is also the word with the smallest linear index in S,
or the word with the greatest linear index in P is also the word with the greatest linear index in S.

(Ex-22) $Good_1\ girls_2\ read_3\ books_4$.

There are two primary constituents in (Ex-22): *good girls* and *books*. *Good girls* is

peripherally localized because the word with the smallest linear index (={1}) in the primary constituent *good girls*, namely *good*, is also the word with the smallest linear index in the whole structure *good girls read books*. Conversely, *books* is peripherally localized because it is the word with the greatest linear index in the primary constituent *books* and in the whole structure. Thus, peripheral localization leads to a structure where the head is bracketed by its primary constituents.

In an *echo-localization* the localization of primary constituents, the order of the primary constituents *echoes* the alignment of zone-commanding morph(eme)s in the head-structure.

(D-23) Two primary constituents P_1 and P_2 are *echo-localized* as $\#P_1\text{-}P_2\#$
iff the head-structure of a head H is $\#M_1\text{-}M_2\#$
and M_1zone-commands P_1
and M_2 zone-commands P_2.

(Ex-23) Wenige Bücher lesen nur dumme Mädchen.
"Only stupid girls read few books."

Nur dumme Madchen (= *only stupid girls*) and *wenige Bücher* (= *few books*) are primary constituents of *lesen* (= *read*). The flexeme *+en* (= M_2) of *lesen* zone-commands *nur dumme Mädchen* (= P_2), and the verb stem *les* (= M_1) zone-commands *wenige Bücher* (= P_1). Since, the head-structure is $M_1\text{-}M_2$ and the primary constituents appear as $P_1\text{-}P_2$ the primary constituents are echo-localized.

In a *mirror-localization* the localization of primary constituents is a mirror image of the alignment of zone-commanding morph(eme)s in the head-structure.

(D-24) Two primary constituents P_1 and P_2 are *mirror-localized* as $\#P_2\text{-}P_1\#$
iff the head-structure of a head H is $\#M_1\text{-}M_2\#$
and M_1 zone-commands P_1
and M_2 zone-commands P_2.

(Ex-24) Lesen brave Mädchen Bücher?
"Do good girls read books?"

Brave Mädchen (= *good girls*) and *Bücher* (= *books*) are primary constituents of *lesen* (= *read*). The flexeme *+en* (= M_2) of *lesen* zone-commands *brave Mädchen* (= P_2), and the

verb stem *les* (= M_1) zone-commands *Bücher* (= P_1). Since, the head-structure is M_1-M_2 and the primary constituents appear as P_2-P_1 the primary constituents are echo-localized.
If primary constituents in a sentence are peripherally localized and mirror-localized, they are considered as being *cross-localized*.

(D-25) Two primary constituents P_1 and P_2 are *cross-localized*
iff P_1 and P_2 are mirror-localized,
and P_1 and P_2 are peripherally localized.

(Ex-25) A good girl reads books.

Since *a good girl* and *books* are peripherally localized and mirror-localized, they are also cross-localized. It is important in my opinion to stress the fact that what is currently referred to as *adjacency* in English as a necessary requirement for word ordering, is in fact a cross-localization. The primary constituents are only adjacent to the head *reads*, but not to their respective zone-commanding morph(eme)s. This has never been taken up by anybody working in the generative grammar framework!

In the attempt to describe—and possibly predict—different word orders, transformational syntax theories assume base structures. Base structures are—often very abstract—assumptions on certain structures that form the starting point of all kinds of possible word order changes. However, in many transformational theories, the term "base structure" not only has a technical standing, there is also a more sublime understanding of the term in a neurological and cognitive sense.
In zone theory, *base structure* is used in a purely technical sense with no assumptions about linguistic neurology whatsoever. To emphasize this point, the definition of *base structure* requires that candidates must be acceptable utterances of natural languages. Designating a structure as a base structure does not imply, however, that this structure is in any way simpler or more primary than structures that can be—technically—derived from it.
The definition of *base structure* first requires the definition of two types of *cycles*.

(D-26) A *cycle* is constituted by a head H and its primary constituents P_1-P_n
iff P_i is located in the remote zone RZ.

(Ex-26) Ich weiss, dass er gestern ein Buch kaufte.

"I know that he bought a book yesterday."

The whole sentence (Ex-26) is a cycle because *ich* is located in the remote zone. However, the embedded clause *dass er gestern ein Buch kaufte* is also a cycle, because *er* is located in the remote zone with respect to the head *kaufte*.
The definition of matrix *cycle* requires furthermore the term *initial element*:

(D-27) A word W is an *initial element*
iff W is not a general successor of any other word X.

In (Ex-26), the verb *weiss* is an initial element because there is no other word in the sentence of which *weiss* is a general successor.
Consequently, a *matrix cycle* is a cycle where the head is not a general successor of another word.

(D-28) A head H and its primary constituents P_1-P_n constitute a *matrix cycle*
iff H and P_1-P_n constitute a cycle,
and H is an initial element.

In (Ex-26), the whole sentence is a matrix cycle, while the embedded clause is only a cycle, but not a matrix cycle.
A *base structure* then is a cycle which constitutes an acceptable utterance, and where the remote zone and the close zone are mirror-localized if the close zone is closer to the head-structure than the remote zone, or where the remote zone and the close zone are cross-localized if the close zone is not closer to the head-structure than the remote zone.

(D-29) A cycle C is a *base structure*
iff C is an acceptable utterance,
and the remote zone RZ and the close zone CZ are mirror-localized,
and CZ is *closer* to the head-structure H of C than RZ,
or, if there is no mirror-localization, then RZ and CZ are cross-localized.
(Ex-29.1) (dass) brave Mädchen viele Bücher lesen.
"(that) good girls read many books."

(Ex-29.2) Lesen brave Mädchen viele Bücher?
"Do good girls read many books?"
(Ex-29.3) Brave Mädchen lesen viele Bücher.
"Good girls read many books."

In German, among the sentences (Ex-29.1-3), (Ex-29.1) must be the base structure because the primary constituents *brave Mädchen* and *viele Bücher* are mirror-localized, and the close zone *viele Bücher* is closer to the head-structure *lesen* than the remote zone *brave Mädchen*. (Ex-29.2) cannot be a base structure because the primary constituents are echo-localized, but not mirror-localized. (Ex-29.3) cannot be a bast structure because there is already a structure that qualifies with mirror-localized primary constituents. In English, the base structure is the same in (Ex-29.1-3) with the primary constituents *good girls* and *many books* being cross-localized.

In order to talk about the changes word order instantiates, the resulting structure by changing the word order of a base structure has to be described with respect to its base structure. Therefore, the original position of a primary constituent or a head in its base structure, and the resulting position in its word order changed structure must be distinguished. A *source position*, thus, is the position primary constituents and their head take in the base structure.

(D-30) A localization of a primary constituent P or a head-structure H is a *source position*
iff P or H are localized in a base structure.
(Ex-30) (dass) brave Mädchen viele Bücher lesen.
"(that) good girls read many books."

In (Ex-30), the primary constituents *brave Mädchen* and *viele Bücher*, and the head *lesen* take source position because they are located in a base structure. If a structure is not a base structure, at least one primary constituent or the head must take a different position than their source position. This new position is called *goal position*.

(D-31) A localization of a primary constituent P or a head-structure H is a *goal*

position
iff P or H are not localized in a source position.

(Ex-31.1) Lesen brave Mädchen viele Bücher?
"Do good girls read many books?"

(Ex-31.2) Brave Mädchen lesen viele Bücher.
"Good girls read many books."

In (Ex-31.1), the head *lesen* is on a goal position, because (Ex-31.1) is not a base structure, and because *lesen* has a different location in its base structure (Ex-30).
In (Ex-31.2), both the head *lesen* and the primary constituent *brave Mädchen* are in goal positions, because they are not in their source positions.
The change between a structure where all elements take source position and a structure where at least one element takes goal position, can be called *movement*. This term implies the notion that that element which is on a goal position has *moved* there from its source position.

(D-32) A primary constituent P or a head-structure H have *moved* to a goal position
iff P or H are not localized in a source positions.

(Ex-32.1) Lesen brave Mädchen viele Bücher?
"Do good girls read many books?"

(Ex-32.2) Brave Mädchen lesen viele Bücher.
"Good girls read many books."

The primary constituent *brave Mädchen* is considered as having moved from its source position in (Ex-32.1) to a goal position in (Ex-32.2). If a structure can be formed by moving one element from another structure to a position it did not previously take, the first structure will be regarded as having *derived* from the latter.

(D-33) A structure T has *derived* from a structure S
iff T can be formed by the movement of at least one element of S.

The terms *movement* and *derivation* are likely to get mixed up with the concept of transformations in transformational constituency grammars. The crucial difference,

however, is that zone theory does not make assumptions on language acquisition and related neuro-linguistic theories. Whether human beings perform—albeit unconsciously—transformations on linguistic structures in respective brain centers is still not decided. Evidence is more than thin in this respect.

Dependency theory as a linguistic theory deals with the analysis of *result structures* of linguistic action. I.e. people speak or write, and the results of these actions, namely sound structures and sign structures are analyzed with respect to their syntax by dependency theory. Linguistic action is among all actions human beings can perform, a *poeitic* action. Poeitic actions are those actions that leave a trace after performation. Painting a picture is a poeitic action, because once the action is performed, there is a trace of this specific action, namely the picture. Speaking is a poeitic action that leaves ephemere traces, namely sounds that are very short-lived. However, from a certain technological state on, you are able to use devices that record sound, and thus are able to conserve speech traces and make them more long-lived. Writing leaves comparatively long-lived traces, but only in comparison to speaking; it depends on the durability of the medium used to conserve writing symbols how long-lived the writing traces are going to be.

The analysis of linguistic traces as results structures is *per se* limited. It appears to me that in the same manner as it is for all practical purposes impossible to deduce the internal psychic state of a painter from chemical analysis of the colors used in her paintings, linguistics is speculative when it tries to deduce internal workings of the linguistic brain centers from syntactical analysis of linguistic result structures.

For this reason, neither *movement* nor *derivation* (along with *base structure*, *source* and *goal position*) imply any assumptions about the workings of our brains. They are merely abstract and technical devices to calculate statements on linguistic structure—in this paper: syntactic structures. In this respect, I again emphasize that the notion of base structure does not relate to a fictitious structure that may or may not be a neuro-linguistic form on which syntax operates in the brain. It is merely the starting structure in a calculus for word order change. The calculus I have in mind is not expansive or cumulative like most logical calculi, but permutative. That means that a structure does not expand in quantity by application of rules, but that elements of the structure change position.

For example, in German a yes/no-question is derived by moving the head from its source position at the right periphery of the structure to a source position on the left periphery of the structure. The rule required here would be something like *move the head to the left*

periphery! We find that a simpler rule will derive all possible structures for a German base structure.

(1) (dass) [das Mädchen gestern] RZ [in einem Buchladen ein Buch]CZ kaufte
(2) kaufte [das Mädchen gestern] RZ [in einem Buchladen ein Buch]CZ?

The rule *move the head to the left periphery!* has been applied to (1) and yields (2). In a next step, we can apply the rule *move exactly one primary constituent to the left periphery!* This will yield any sentence below:

(3.1) das Mädchen kaufte [gestern] RZ [in einem Buchladen ein Buch]CZ.
(3.2) gestern kaufte [das Mädchen] RZ [in einem Buchladen ein Buch]CZ.
(3.3) in einem Buchladen kaufte [das Mädchen gestern] RZ [ein Buch]CZ.
(3.4) ein Buch kaufte [das Mädchen gestern] RZ [in einem Buchladen]CZ.

Although the sentences (3.1–4) consists of the same elements, they are not completely equivalent in pragmatic terms, but rather answers to different questions. It also depends on whether there is stress on the first element or not.
In German, there are thus two major rules:

(R-1) *move the head to the left periphery!*
(R-2) *move exactly one primary constituent to the left periphery!*

However, (R-2) can only be applied once. The same is true for English, although not every primary constituent can be moved. English starts with a base structure such as (4.1). For this reason, the only movement that can apply at all is (R-2).

(4.1) [the girl]RZ bought [a book in a bookshop]CZ [yesterday]RZ.
(4.2) yesterday [the girl]RZ bought [a book in a bookshop]CZ.
(4.3) * a book, [the girl]RZ bought [in a bookshop]CZ [yesterday]RZ.
(4.4) * in a bookshop [the girl]RZ bought [a book]CZ [yesterday]RZ.

English makes use of (R-2), but it cannot be applied to close zone elements. In English,

subjects and objects stay adjacent to their respective heads. That can be shown by the following sentence:

(5) Did the girl not buy a book in a bookshop yesterday?

In (5) *the girl* is adjacent to *did*, and *a book* to *buy*. That *the girl* is not adjacent to *buy*, is illustrated by the position of *not* between *the girl* and *buy*.
In *wh*-questions on any constituent other than the subject, (R-2) applies to any constituent:

(6.1) What did [the girl]$_{RZ}$ [buy [in a bookshop]$_{CZ'}$]$_{CZ}$ [yesterday]$_{RZ}$
(6.2) Where did [the girl]$_{RZ}$ [buy [a book]$_{CZ'}$] [yesterday]$_{RZ}$
(6.3) When did [the girl]$_{RZ}$ [buy [a book in a bookshop]$_{CZ'}$]$_{CZ}$

With respect to (6.1-3), it must be remarked that *buy* and all its general successors form a close zone CZ, while *buy* itself acts as a head-structure for CZ'. This embedded zoning happens whenever a natural language uses periphrastic tenses or modi.
For instance, Japanese does not have periphrastic constructions for tense or modus, but incorporates all features into the finite verb mainly by agglutination, sometimes also by a process close to fusion. In comparison to German and English, Japanese is also remarkable that the subject is not localized in the remote zone. Since there is no morph(eme) other than the verbal lexeme on which subject primary constituents are proto-dependent, Japanese subjects may not be located into a remote zone if they are not marked other than with the nominative case marker =*ga*.
However, if a subject—or for that matter any other phrase—is marked with the exclusive focus marker =*wa* instead of nominative =*ga*, then the subject moves from the close zone into the remote zone. The exclusive focus marker =*wa* tends not to appear with verbs that are not inflected with a finite flexeme, or with a flexeme that carries an actual finite function.

(7.1) 私は本を買った。
watashi=wa hon=o kat.ta.
'I' =exclusive focus / 'book' =accusative / 'buy' +perfect tense
I bought a book.

(7.2)　私が本を買うことは多い。
watashi=ga hon=o ka.u koto=wa oo.i.
‘I’ =nominative / ‘book’ =accusative / ‘buy’ +present tense / ‘matter’ =exclusive focus / ‘frequent’ +present tense
It does happen a lot that I buy a book.

In (7.1) the verb *kat.ta* is finite, and the flexeme *+Ta* commands the exclusive focus marker as all finite flexemes do in finite position. In (7.2), however, the verb *ka.u*, although *+Ru* is a finite flexeme, is not in finite position and therefore unable to assign the exclusive focus marker. The exclusive focus marker at the end of *koto* is assigned by the finite flexeme *+i* of the adjective *oo.i*.
Causative constructions in German and English are periphrastic constructions; in Japanese a suffix verb *–Sas.u* or *–Sase.ru* is suffixed to the verb. This leads to different syntactic constructions, and to different zoning:

(8.1)　Ich lasse ihn ein Buch kaufen.
(8.2)　I let him buy a book.
(8.3)　私は彼に本を買わせる。
watashi=wa kare=ni hon=o kaw.ase.ru.
‘I’ =exclusive focus / ‘he’ =dative / ‘book’ =accusative / ‘buy’ -causative +present tense

All sentences (8.1–3) mean the same. However, German and English share the same zone structure, while Japanese has a different one.

(9.1)　[Ich]$_{RZ}$ lasse [ihn [ein Buch] $_{CZ'}$ kaufen] $_{CZ}$.
(9.2)　[I] $_{RZ}$ let [him buy [a book] $_{CZ'}$] $_{CZ}$.
(9.3)　[watashi=wa]$_{RZ}$ [[kare=ni] $_{CAUS}$ [hon=o] $_{LEX}$] kaw $_{LEX}$.ase $_{CAUS}$.ru.

In (9.1), the accusative *ihn* and the constituent *ein Buch kaufen* is zone-commanded by the causative lexeme verb *lass*, while the flexeme *+e* zone-commands the remote zone subject. The analogue is true for the English sentence (9.2). In (9.3), however, the dative *kare=ni* is zone-commanded by the causative suffix verb *–ase*, while the object *hon=o* is

zone-commanded by the lexeme verb *kaw*.

The principal problem in Japanese, if zone theory is applied, is not that subjects—other than German and English subjects—are not automatically located in the remote zone. If Japanese subjects *and* other constituents are located in the close zone, how should close zone constituent order look like? Is there sufficient evidence to place the subject in front of the object in Japanese base structure in a way as to ensure that Japanese is truly a SOV-language? It turns out that there is such evidence, but only for structures with nominative and accusative marked constituents. This can be proved by looking at floated quantifiers in Japanese (cf. Gross (1999a: 141ff)).

(10.1) 学生は三人本を読んだ。
gakusei=wa san.nin hon=o yon.da.
'student' =exclusive focus / 'three' -person / 'book' =accusative / 'read' +past tense
Three students read books.

(10.2) 学生は本を三冊読んだ。
gakusei=wa hon=o san.satu yon.da.
'student' =exclusive focus / 'book' =accusative / 'three' -book / 'read' +past tense
The students read three books.

In (10.1), the quantifier *san.nin* refers to *gakusei* which is indisputable since the suffix noun *–nin* must refer to people, not to books. There was a certain amount of discussion about the question what kind of phrase structuring there was to be assumed to hold between *gakusei* and *san.nin*, but it is safe to say that post-nominal quantifiers are not in the syntactic domain of the host nouns. This assumption is corroborated by the fact that no Japanese quantifier takes case markings when in a verbal syntactic domain. As a consequence, the quantifier *san.nin* in (10.1) is a primary constituent of *yon.da*, because *yon.da* prohibits any case marking for *san.nin*. The same is true for (10.2) where *san.satu* clearly refers to *hon*.
If Japanese had a SOV-order, then movement of the object *hon* to the left periphery should render the subject between the quantifier and its host noun. If, however, on the contrary Japanese had a OSV-order then the movement of the subject *gakusei* to the left periphery

should render the object between the quantifier and its host noun. The next two sentences show, that the assumption for OSV does not hold, and that it must be concluded that the word order for subjects and objects is SO.

(11.1)　本を学生は三冊読んだ。
　　The students read three books.
(11.2) *　学生は本を三人読んだ。
　　Three students read books.

However, if the subject occurs together with a complement other than the object or with an adjunct, then the subject must be closer to the verb in the base structure.

(12.1)　学生はオフィスに二人来た。
　　gakusei=wa ofisu=ni hutari ki.ta.
　　‘student’ =exclusive focus / ‘office’ =dative / ‘two~people’ / ‘come’ +past tense
　　Two students came to the office.
(12.2)　ドアがこの鍵で二つ開いた。
　　doa=ga kono kagi=de hutatu ai.ta.
　　‘door’ =nominative / ‘this’ / ‘key’ =essive / ‘two~things’ / ‘open’ +past tense
　　Two doors opened with this key.

In (12.1) the allative complement *ofisu=ni* occurs between the subject and the quantifier *hutari* in exactly the same position that *hon=o* occurred in in (11.2). In (12.2) it is the instrumental adjunct *kono kagi=de* that occurs in the same position. However, unlike (11.2), (12.1) and (12.2) are acceptable. This means that Japanese subjects in the base structure are closer to the head-structure than other complements or adjuncts. Among other things that is a very strong indication that Japanese subjects are located in the close zone.

Zone theory is thus able to provide something very important to the dependency theory framework, namely the idea of abstract categories such as zones and head-structures that can be used to account for localization preferences in different languages. As these categories are by their definitions rooted in previously defined dependency terms, they are also rooted in dependency theory itself.

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