

Syntax–Semantics Interface

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Abstract

I introduce the topic by pointing out some common problems and disagreements in defining the notions of syntax and semantics. Avoiding theory-specificity and adhering to no particular linguistic school, the article makes minimal assumptions about the notions to arrive at a description of syntax–semantics interface. Among the topics discussed are logic, truth, meaning and their relevance to syntax and semantics, syntactic and semantic validity, and semantics' relations to core areas of syntax (word order, grammatical relations, and constituency). The main claims are (1) a robust correlation between semantic and syntactic validity and (2) that grammatical relations and constituency are largely determined by semantics, while certain forms of word order are autonomous.

Introduction: Syntax/Semantics

The notions of syntax and semantics are widely used beyond linguistics (e.g., in mathematical logic and computer science, not to mention their colloquial usage) but the present article focuses on their application on natural languages (Semantics). In linguistics, the notions are by no means strictly defined, and estimates as to what is what and where to draw the line between the two vary considerably (Jackendoff, 2002: pp. 268–277). Thus, at this stage, it is useful to think of the domain we are interested in as syntax/semantics, and to keep in mind that different theories partition it into syntax and semantics in different ways. A (or perhaps the) crucial difference between different schools is whether phrasal and sentential semantics is allowed. In generative grammar (originating in Chomsky, 1964 [1957]), at least in its recent emanation (Berwick et al., 2013), only lexical items (basically, words and morphemes) can have semantics (see Generative Grammar; Lexicon). By contrast, there are approaches focusing mainly on phrasal and sentential semantics, e.g., frame and formal semantics and semantic syntax (originating in Fillmore, 1976; Montague, 1970; Seuren, 1996, respectively). This picture is further complicated by the fact that syntax and semantics are already very different by their nature (see Sections [Syntax](#); [Semantics](#); and [Syntax–Semantics Interface: Preliminaries](#) for details). While everybody regards meaning as central to semantics, views on what is (central to) syntax are much more variegated. Syntax has at least three distinct focal parts – word order, grammatical relations, and constituency – and their roles, contents, and interrelations are widely debated by different theories (see Sections [Constituency](#); [Grammatical Relations](#); and [Word Order](#) for details; (cf [Word Order](#); [Grammatical Relations](#))). In some ramified approaches to sentential semantics, it may be possible to derive grammatical relations and hierarchical sentence structure (constituency) from semantics, leaving only the cross-linguistically highly variable word order for syntax. The gulf between what could be termed as syntacto- and semantocentric views on syntax/semantics is also evident in their claims about the universality of syntax or semantics. For generative grammarians, syntax is universal and semantics (except for the general principle of form-meaning relation) highly language-specific, while a semantocentric view is the direct opposite. In addition, the approaches have generally

opposing research agendas. As referred above, a semantocentric agenda is largely shaped by questions like how much of constituency, grammatical relations, and word order can be derived from semantics and pragmatics. By contrast, in the history of generative grammar, the role of semantics has gradually diminished and the function of syntax expanded (cf Berwick et al., 2013; Chomsky, 1964[1957]; Jackendoff, 2002).

Due to innumerable fundamental discrepancies between different approaches and schools, as well as for some peculiarities of natural language and its study, it seems impossible to give an objective overview of syntax/semantics, much less of the syntax–semantics interface. However, if we ever plan to get anywhere with this we would better start somewhere.

Partitioning Syntax/Semantics

To arrive at a description of syntax–semantics interface, we must start with a few axioms about syntax and semantics. Given the state of theorizing in this field, one cannot hope for our axioms to be both strong and universal (or uncontroversial); nevertheless, if we want to progress we have to posit some. In reading indiscriminately what has been written about syntax/semantics in the last few hundred years, one may observe the following general principle:

1. Syntax pertains to the ordering of elements, while semantics deals with their meanings.

Usually, the 'elements' are meaningful elements – thus, for example, the ordering of phonemes does not belong to syntax. However, this is by no means uncontested. According to Berwick et al. (2013), syntax is also responsible for the ordering of phonemes. Admittedly, this is something with which no other approach that I know of concurs. Besides, when viewed like this, the scope of syntax would be much wider than that of semantics, which deals only with meaningful elements by our definition. Thus we are tempted to set the additional condition:

2. The elements in (1) are meaningful.

From (1) and (2), one can deduce an important dependency:

3. Syntax depends on semantics but the converse does not hold.

As a test that the converse does not hold, take any known word in natural language, and observe that it has meaning irrespective of its context. This follows from the definition of elementary word: a minimal unit of language understood (but not necessarily used) outside context (Luuk, 2010). As another test, consider the sentence:

4. *He teached them,*

which is morphosyntactically (see Section [Syntax](#)) invalid but semantically valid (i.e., readily understood). We end this section with an observation which, although not particularly illuminating or important, is still worth mentioning: Both the objects of study and the disciplines studying them are called syntax and semantics, so we should alert ourselves to this potential difference in these words' meanings.

Syntax

The context, i.e., the ordering meant (and studied) by syntax, is fundamentally determined by the condition of temporal representation over serial channel. In spoken languages this manifests itself as a sequence of sounds, in written language as the scanning sequence in reading, in signed language as a sequence of manual signs. There is a subtle point as to whether the order of morphemes (the smallest meaningful units in natural language) belongs to the domain of syntax. On one hand, many morphemes are words, but on the other hand, there is an entire discipline (and level of language) – morphology – generally viewed as distinct from syntax dealing with them (see *Morphology in Linguistics*). In fact, quite a few researchers would be willing to dismiss syntax and morphology as independent disciplines altogether and speak of morphosyntax instead (cf [Hengeveld and Mackenzie, 2008](#)). From a logical viewpoint, as a study of orderings of linguistic signs, morphosyntax would make perfect sense. (In this article, linguistic sign and linguistic expression mean the same.) However, unfortunately 'morphosyntax' has been used in another sense already, and for historical (as well as synchronic, typological, and terminological reasons) syntax has, at least for the last 100 years, vastly overshadowed morphology. For a major typological reason, there are languages like Classical Chinese that admittedly lack morphology (in the sense of lacking morpheme compounding, not in the sense of lacking morphemes, which would be impossible for any language). On the other hand, no language could lack syntax because no language lacks words, the main building blocks of syntax (note that word compounding is never an issue, and probably lacking in a vast number of languages). Thus the reason for this superiority of syntax is an important definitional asymmetry: syntax is mainly about word ordering, while morphology is about morpheme compounding and ordering. This last 'and' makes morphology's domain much more restrictive, essentially equating it with the intersection of morpheme compounding and morpheme ordering. The domain of syntax is more elementary, although in the analysis of levels (of linguistic representation, semantics, etc.) morphemes are more elementary than words.

The vast majority of syntactic rules are language-specific (see Section [Syntax–Semantics Interface: Preliminaries](#)). However,

some cross-linguistically universal synchronic (e.g., (1), (7), and head-dependent relation – see Section [Constituency](#)) and diachronic principles remain. In general, the syntax of any language at a particular moment is partly coincidental and partly determined by the phase of grammaticalization cycle that the language is currently in (cf *Grammaticalization*). By coincidental I mean the result of a complex interplay of diverse historical factors such as migration, occupation, technology, war, language contact, language prestige, true accident, etc. that we will never disentangle (cf *Language Contact*).

Semantics

When one considers levels of linguistic representation – phoneme, morpheme, word, phrase, sentence, and discourse – semantics pertains uniformly to all of them except phoneme. Put differently, all these five levels have meaning, thus semantics by (1). However, the meaning constructed (or extracted) on one level may in some respect differ from that on the others. Semantics is uniform in the sense that it has only one general rule:

5. Form-meaning correspondence.

Note that this view of semantics does not address the definition of meaning, which must be specified separately (see Section [Predicates, Arguments, and Meaning](#)). The universality of rule (5) (essentially, a definition of sign) stretches far beyond language, as (5) describes all natural and artificial communication systems. Semantics is also uniform in the sense that it is cross-linguistically universal (as testified by the possibility of translation – cf [Haspelmath, 2007](#)). Succinctly speaking, semantics is a function that, given a form as input, returns its meaning(s) – assuming there are any. If there is more than one meaningful input, the relation will attempt to compose the meanings of its arguments. For example, as the sentence is a combination of meaningful units, its meaning is generally compositional (as usual in language, there are few exceptions, like *it rains*, where *it* has clearly no meaning whatever – although *it* as a pronoun has a meaning). On the other hand, the meaning of a morpheme is usually elementary (of which there is a plethora of examples, e.g., the noun stem *cat* or the noun class (or gender) markings for feminine and masculine). Several other morpheme types (e.g., most cases, adpositions, tense-aspect-mood) mark relations between more than one input, and have thus compositional meanings involving predicates with two to four arguments. Four arguments seem to be (close to) the attested grammatical maximum, probably due to the constraints on short-term memory ([Cowan, 2001](#)).

Predicates, Arguments, and Meaning

Mathematically, predicate is a function from a set A to a special two-element set. In the context of language (and mathematical logic), the two elements are usually taken to be true and false (cf *Logic and Linguistics*). Assuming that the values are true and false, and since function is a subcase of relation, predicates describe the truth or falsity of relations. In the

simplest case, the relation could be, e.g., belonging to a subset B of A. If this is the case, the predicate P that represents the relation is true of an argument x (usually written $P(x)$ or Px) iff x is an element of B and false ($\neg Px$) otherwise. In this case we say that P is the characteristic (or indicator) function of B. Thus, predicates are a convenient way of addressing truth, falsity, sets, relations, functions, and (other) predicates. Given all this, it might occur that they are also a convenient way of addressing meaning. In the traditional model-theoretic sense, the meaning of a sentence is its truth-conditions (Davidson, 1967). In a more refined (but still entirely model-theoretic) sense, the meaning of a sentence is the proposition expressed by the sentence as the set of circumstances in which it is true (Soames, 1992: p. 29). Admittedly, I have a difficult time distinguishing these definitions, but they are purportedly different (Soames, 1992), so it makes sense to mention both. In either case, meaning boils down to a set of circumstances. Now circumstances are relations, and relations can be expressed as predicates – which is all the more appropriate since the circumstances are required to be true (and it is difficult to get around with truth without predicates). The frequent argument that only (declarative) sentences can have meanings is immaterial, because one can take, e.g., *cat* as a one-place predicate (which is true if used in reference to the right type of creature). In a suitable context, even a single word can produce a reference. Also, one should not be too daunted by the standard counterargument to this type of theory of meaning, concerning the truth-conditions of sentences that are always true (such as *it rains or it does not rain or both and $1 = 1$*). It is namely claimed that all such sentences have exactly the same truth-conditions, whereas in fact there are ways to filter out the relevant circumstances (but we will not delve further into this issue here). In sum, we seem to have a mathematically precise way of addressing meaning as a (set of) predicate(s). Note that this does not tell anything about how or whether these predicates are implemented in the brain, so there is no conflict with representation or concept-based theories of meaning (of which there are many – e.g., Gärdenfors, 1998; Jackendoff, 2002; Langacker, 1990; Luuk, 2013a). After all, predicates are somehow implemented as concepts in our consciousness. If so, why could not they be implemented on some lower conceptual level? (See Hurford (2003a,b) for a claim that predicates and arguments can be distinguished on a perceptual level already.)

Syntax–Semantics Interface: Preliminaries

Both semantics and syntax are rule systems but the rules involved are very different. As we saw above (see Section Semantics), there is only one general rule in semantics, holding far beyond natural language. Differently from animal communication systems, there is usually no one-to-one correspondence between linguistic form and meaning (Ferrer-i-Cancho et al., 2005). This (possibly) unique property of natural language facilitates expressivity, creativity, ambiguity, and making mistakes. Syntax, on the other hand, is a relatively complex

6. combinatorial system of dependency, agreement, and linear ordering rules,

the sole purpose of which appears to be mapping meanings to a serial channel (by (1)). Differently from (5), (6) and even the weaker (7) are uniquely human. In addition, the vast majority of syntactic rules are language-specific, and only a tiny fraction of them is known, because there are (or recently were) 6000–7000 languages in the world. The staggering typological diversity of syntactic rules is a testament to the degree of freedom the meaning mappings have. Indeed, it seems as if anything is allowed as far as the rules strike a (sub)optimal balance between minimum effort and maximum precision. This is a complex task, with trade-offs in at least three dimensions: both for the speaker and hearer individually and between them (producing vs processing effort). The sole criteria for such a balance seem to be communicative and propagative success (by the latter is meant the propagation rate of a syntactic structure in the community).

In a sense, “mapping meaning to a serial channel” is an understatement – if a mere mapping would be involved in syntax, a sequence (a concatenation) of signs would do. Granted, perhaps not any sequence but, even if we constrain the sequences, the core of full syntax does more than just concatenate signs – it also compounds and embeds them. The difference between concatenation and compounding is that in the latter the signs are necessarily interpreted together. The difference between compounding and embedding is that only the latter allows for center insertion and (potentially) more than two-level nesting. Note that embedding has a broader definition (a meaningful unit in another meaningful unit) here than in the traditional syntactic literature. For example, a morpheme in a word is an instance of embedding in this broader sense.

As mentioned above, differently from the principle of semantics (5), the principle of syntax:

7. a combination of meaningful elements by (morpho-) syntactic rules,

is uniquely human (Hurford, 2004; Jackendoff, 1999; Ujhelyi, 1998). This claim is not particularly surprising, given that (morpho)syntactic rule as such is uniquely human (if we adhere to definitions (1) and (2) – if phonological sequences are included in syntax, birds may have it). Thus syntax must have emerged relatively recently by the evolutionary scale. In fact, we have also some evidence to base our conjectures on how it evolved. For example, it can be shown that syntax evolved from concatenation to compounding to embedding, whilst retaining all the preceding procedures (Luuk and Luuk, 2014). As virtually all modern analyses concur, protolanguage started with few isolated signs (cf Bickerton, 2007; Jackendoff, 1999; Johansson, 2006). Only after that could certain rules be applied to them. Despite possible claims to the contrary (Bickerton, 1998; Chomsky, 2010), it is implausible that a complex rule system like syntax emerged suddenly full-fledged as a result of some mutation or otherwise. A gradualist scenario is much more likely (Pinker and Bloom, 1990). To be precise, the claims (at least that of Chomsky) are about the abrupt emergence of language faculty, the core of which would be a capacity for syntax. This is something completely different from an abrupt emergence of full syntax

in a linguistic community, which, as said, is implausible (and probably also impossible).

Syntactic and Semantic Validity

It is frequently claimed that syntax and semantics are two entirely different systems, domains or dimensions, which have little (if anything) in common except for the need for a common interface. This may be so – since (and as long as) the notions are not strictly defined, not much seems to hinge on the truth or falsity of this claim anyway. Another frequently advanced claim is that there is a double dissociation between syntactic and semantic validity. If this were the case, we would have rather substantive evidence for syntax and semantics being autonomous systems of linguistic representation. As the claim about dissociation seems quite well-articulated, we might be even able to test it. So let us examine this claim in more detail.

We mentioned above the principle of syntax: a combination of meaningful elements by (morpho)syntactic rules. It has been allegedly shown that this function can be separated from semantics. The commonest example is (Chomsky, 1964[1957]):

8. *Colorless green ideas sleep furiously.*

This is taken to be an example of a sentence that is syntactically valid but meaningless (that is, presumably, semantically void). However, the truth-conditions for this sentence (the circumstances under which it could be true) are

9. If green could be colorless and ideas green, and if sleep could be furious and ideas sleep (then (8) could be true).

If we accept the standard model-theoretic stance that truth-conditions are (or yield) the meaning, the meaning of (8) is somehow given by (9). The circumstance that the relations in (8) happen to be false in our world is irrelevant. Whether or not a truth-condition is satisfied in a (or in any) model is immaterial for its existence. What is required is a structure where it can be interpreted. Observe that the actual world is such a structure since it has all the necessary predicates (coinciding with the words in (8)). This structure allows for the interpretation of the meaning (i.e., truth-conditions) of the sentence (8) that is always false in the structure. After all, if it did not, how would one know that the sentence is false in the actual world?

In sum, and in light of what we said about the asymmetric dependency between syntax and semantics (3), one is led to the view that all syntactically valid expressions are also semantically valid but not vice versa. As a further test, consider the strings

10. *askldfjklkdjkl sdfaklj fkkdfj*

11. *the wug drunted geperfully*

12. *you runs*

13. *this is a house*

(10–13) exhibit a gradation of general semantic/syntactic validity (well-formedness, if you will) from zero to maximum. In each of them, a robust correlation between syntactic and semantic validity is evident. In (10), both are (near) zero. Pseudo-expressions like (11) are sometimes erroneously viewed as examples of syntax–semantics dissociation. In fact, it is easy to see that everything syntactically valid about (11) is

also meaningful, i.e., valid semantically. Let us try to analyze this string, starting from syntax. First, there is the noun phrase (NP) *The wug*, signaled by the article as well as ‘word’ order. Second, the ‘verb’ *drunted* – technically not an English verb but readily interpreted as one owing to the past tense suffix *-ed* and ‘word’ order. Finally, the ‘adverb’ *geperfully* modifying (as adverbs do) the ‘verb.’ We do not know how exactly it does that but a modification (as such) is evident. Like the ‘verb,’ the ‘adverb’ is signaled by a suffix (*-fully*) and ‘word’ order. Now turn to semantics. It is not difficult to see that all we said about syntax reflects in the string’s meaning. In fact, everything in (11) except for the ‘stems’ *wug*, *drunt*, and *geper* is meaningful. We have a definite (*the*) agent that was engaged in an activity (in a loose sense) in a specific way (although we do not know, which) in the past. Admittedly, this is a lot of meaning (as compared to, e.g., (10)), and the fact that it was extracted mostly from syntactic rules and categories does not make it less valid. It merely shows that not only stems but all morphemes and even specific word orders (such as *the x*) have meaning, and that semantics probably cannot be dissociated from syntax (while the converse is possible by (3)). (12) is defective morphosyntactically (the agreement failure) and semantically (2nd and 3rd person clash), but its syntactic and semantic interpretations are constrained much better than those of (10–11). In fact, only three readings suggest themselves – *you run*, *your runs*, and (*s*) *he runs* – so as compared to the previous examples the expression seems more ambiguous than invalid. (13) is valid syntactically and semantically. In sum, there is a robust correlation between syntactic and semantic validity in all examples (cf *Kako and Wagner, 2001*), corroborating the claim or suspicion (whichever you prefer at this point) that syntax is not an autonomous system of linguistic representation.

Constituency

Constituency refers to the whole–part relation in language expressions. Although one may speak of phonological and morphological constituents, the term ‘constituent’ has a predominately syntactic usage, being mainly reserved for words, phrases, and sentences. In the context of syntax, constituent structure thus refers to words, phrases, or sentences in a hierarchical structure. There are numerous ways to model constituent structure of natural language. This (besides modeling grammatical relations – cf Section [Grammatical Relations](#)) is a bread-and-butter work of theoretical linguists, and most grammatical theories also stipulate their specific constituent structures. Likewise, there is no shortage of methods for describing them (e.g., trees, rewrite rules, bracketing, predicate logic, frame semantics, lambda calculus, categorial grammar, model theory, etc. (cf *Logic and Linguistics*)). Far from being equivalent or complementary, the methods frequently lead to very different views on syntax, semantics, and their interface.

The single most important (i.e., widespread and universal) morphosyntactic rule is head-dependent relation. The essence of a head-dependent relation is that in combining two linguistic units (e.g., in a word or phrase), one of them ‘projects’ or starts governing the other (although it may be not easy to determine

which one). The one projecting is called the head and the other is dependent. Since every head-dependent relation specifies two whole-part relations and three constituents, head-dependent relation yields constituency for free. Since agreement marks syntactic constituents, head-dependent relation provides also the foundation for agreement (cf Grammatical Agreement). In natural language, head-dependent relation and constituency go far beyond syntax, possibly even to phonology. An interesting question for syntax–semantics interface is what determines which elements become heads at phrase and sentence levels. At least in some cases semantics has probably some role in it. For example, the finite verb or flexible (see Luuk, 2010) is the head of the clause and the clause predicate, suggesting that the head may be determined by the semantic predicate-argument structure. Another example is agreement. Lehmann (1982) has argued that only constituents that relate to the same referent may overtly agree with each other.

Grammatical Relations

Grammatical relations (or syntactic functions, as they are sometimes also called (see Grammatical Relations)) hold between clause constituents. Standard constituents in this sense are verb, object, and subject but there are others like modifier, specifier, determiner, etc. (there are many others, most of them specific to particular grammatical theories, of which there are more than 100). Every grammatical relation is stipulated by at least one head-dependent relation (see Section Constituency). A crucial question is how much of grammatical relations are derivable from semantics. As it turns out, a lot. The Chomskian term for this phenomenon is theta criterion: each argument of the (finite) verb is assigned exactly one theta role (semantic role, e.g., agent, patient, goal, etc.) and vice versa. Because of this one-to-one correspondency, it seems that the two – semantic role and syntactic argument – are merely two facets of the same thing, viz. meaning and ('syntactic') form, respectively. But if so, then grammatical relations are fundamentally semantic phenomena, because form-meaning is the general principle of semantics. Furthermore, the supposedly syntactic relations like V, S, O, etc. can be also described with semantic roles in frame semantics or predicates and arguments in a suitable predicate logic. A closely related notion used in generative grammar and elsewhere is subcategorization frame, identifying finite verb's potential positions in phrase structure trees by its class (intransitive, transitive, ditransitive, ergative, etc. (cf Valency and Argument Structure in Syntax)). In generative grammar, subcategorization frame (detached from the verb that appears in it) was believed to be meaningless. However, Kako (1997) experimentally showed this not to be the case (with stimuli resembling (11)). Since subcategorization frames have meanings, it seems that a core part of syntax is semantically driven.

Word Order

All possible (S, V, O) word orders have been attested in the world languages, although some are very rare (the *World Atlas of Language Structures*, <http://wals.info/chapter/81>; (see Word Order)). In languages with (relatively) free word order,

semantics and especially pragmatics (e.g., information structure) are responsible for at least some ordering principles. In languages with fixed word order, semantics has probably a minor role in it. The reason for this is that natural language semantics is order-neutral – nowhere except in formal notations is there a rule to the effect that a predicate should follow its argument(s) or vice versa. If a verb has three arguments (like *give*), it probably makes sense (for processing considerations at least) not to put the indirect object first but this is a pragmatic rather than semantic constraint. Granted, certain fixed orders are meaningful as they specify constituents with specific meanings, be they referents (such as *the x* mentioned above) or relations (e.g., subcategorization frames and prepositional phrases – cf Luuk, 2013b). However, there is no semantic reason for choosing this particular order – we could have determiners following nouns and postpositions instead of prepositions. So, of all the syntactic phenomena we have discussed, at least fixed word order seems largely independent from semantics (and other levels of linguistic representation), thus qualifying syntax as an autonomous level after all (cf Section Syntactic and Semantic Validity). Although we have so far concentrated on cases of semantics determining syntax (partly because they are more difficult to see), this qualification allows us, at least in languages with fixed word order, to consider also the converse cases. There are many such examples, e.g.,

14. *j loves m*
15. *m loves j*

Conclusion

As was noted in the beginning (cf Section Introduction: Syntax/Semantics), an objective account of the syntax–semantics interface of natural language seems unattainable. Although I have tried to shun all major schools and to keep my assumptions to a minimum, I do not know how successful or convincing my case has been in this short introduction to what must be one of the most obscure, complex, and technical areas of natural language. This obscurity and complexity is due to several reasons, which for this particular field unhappily coincide: the great number of opposing linguistic schools; the still greater number of specific grammatical theories; the direct relevance of grammar (and hence of grammatical theory) for a description of syntax–semantics interface; the field's uncomfortable position between two established (yet arbitrarily defined) linguistic levels, hence dependence from both; the relatively central position with regard to all levels (and thus a near-maximum dependency from all of them (and hence also of their descriptions, of which there are many)); and lastly (but most importantly) the scarcity of clear, universal definitions and the (maybe even necessary) lack of a theory-neutral research program. One can only hope that perhaps in a not-so-distant future someone will succeed in advancing this area beyond mere wishful thinking and haphazard theorizing. On a more optimistic note, the great number of linguistic schools and grammatical theories in itself is rather positive – the more theories we have, the greater (albeit likely still very low) the probability of least one of them being (sufficiently) correct.

See also: Grammatical Agreement; Grammaticalization; Language Contact; Logic and Linguistics; Morphology in Linguistics; Valency and Argument Structure in Syntax; Word Order.

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