THE ACQUISITION OF VOCABULARY

5.1

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Milo had never thought much about words before, but these looked so good that he longed to have some. "Look, Tock", he cried, "aren't they wonderful?" "They're fine, if you have something to say", replied Tock in a tired voice. [...] "Maybe if I buy some I can learn how to use them", said Milo eagerly as he began to pick through the words in the stall. Finally he chose three which looked particularly good to him – "quagmire", "flabbergast", and "upholstery". He had no idea what they meant, but they looked very grand and good. (Norton Juster – *The Phantom Tollbooth*)

KEY POINTS:
In this chapter you will learn about:

- **various hypotheses on how children cope with word meaning**
- **constraints which 'guide' the acquisition of words**
- **the relevance of the assumptions with respect to syntax/semantics mapping for the study of lexical development**

1. Introduction

1.1 Vocabulary Growth

In spite of the difficulty of the task, children acquire words extremely fast.

Children acquire lexical items as rapidly as they build grammatical structure. By age 6;00, the vocabulary of a monolingual child contains between 8,000-14,000 words. They learn words at such a staggering speed (approximately 5-9 words per day between 18 months to 6 years of age) that they have been compared to 'lexical vacuum cleaners, inhaling a new word every two waking hours, day in day out' (Pinker 1994a). An English-speaking high school graduate has a vocabulary of about 60,000 words, which means that we have the ability to learn approximately 3,750 new words per year (Bloom 2000).

We have seen that there is a certain developmental pattern with respect to the acquisition of morphosyntax. Can one detect a certain pattern with respect to vocabulary development as well? It seems that children begin by merely showing that they can understand the meaning of words. At this stage, they do not use any word yet. Though the question of what exactly may count as understanding a word casts certain doubt over this hypothesis, parents report that 8 month-olds have a receptive vocabulary ranging in from 15 to over 80 words (Fenson et al. 1994). The gap between comprehension and production seems to continue during the next stages and research results suggest that the gap is more significant in the case of verbs than in the case of nouns (Fenson et al. 1994). Further evidence that comprehension precedes production comes from anecdotal stories about children who began to speak relatively late. Bloom (2000) reports a story about Albert Einstein, according to which his first words would have been uttered when he was about three, one evening at dinner. He put his spoon

down and said: 'The soup is too hot!' The parents were obviously surprised and asked him why he had not talked before. Einstein would have answered: 'Well, up to now, everything has been fine'.

Comprehension seems to precede production in the domain of vocabulary development.

At approximately 10 months, children begin to use words. These early 'words' do not only sound different from the ones in adult vocabulary, but they can also be used in a different way: words naming properties may be used to refer to objects which have that property (for example, *hot* may be used to refer to a radiator) or the same word may be used for both the action and an object (for example, *to fly* may be used to refer to both the action and to birds, Dromi 1987). Lexical constraints are claimed to be inoperative at this stage. The rate of word learning is slow, children only learn a few words and they make many errors.

During the next stage, which begins at approximately 12 months, children begin to use words appropriately, with the adult-like meaning, and they acquire them at a much faster speed.

Once children have learned approximately 50 words (Nelson 1973) and once learning constraints become operative, the increase of vocabulary is extremely rapid, which led some researchers to associate this stage with a vocabulary spurt/ word burst/ word spurt. It is also at this stage that the child realises that language is symbolic, which may account for the rapid increase of their vocabulary. However, other researchers have pointed out that the increase in vocabulary is constant at this stage (around 16-19 months) (Bloom 2000).

A possible pattern of vocabulary growth along time, which supports this latter view, is the one in *Table 1* below:

Word learning is subject to great individual variation.

Table 1:
12 months to 16 months: 0.3 words per day
16 months to 23 months: 0.8 words per day
23 months to 30 months: 1.6 words per day
30 months to 6 years: 3.6 words per day
6 years to 8 years: 6.6 words per day
8 years to 10 years: 12.1 words per day (Bloom 2000:44)

Obviously, word learning can be subject to great individual variation, so the figures in the Table above should be taken as an approximation. Variation may be due to the type of input which the child receives. The extent to which caretakers speak to the child as well as the nature of the input which they provide may influence the speed of vocabulary growth. Children of educated parents tend to know more words at early stages. Also, variation in the ability to learn words may be related to the child's intellectual and social abilities as well as to genetic information. Ganger, Pinker and Wallis (1997) argue that vocabulary growth is more similar in the case of monozygotic twins than in the case of dyzygotic twins. It has also been observed that girls tend to know more words than boys do or that first-born children acquire word meanings faster than later-borns. However, the data seem to differ from one language to another. While French girls score significantly higher than French boys (Kern and Gonnand 2001), recent studies of the early acquisition of vocabulary of Mandarin Chinese monolinguals provide evidence that there are no significant gender differences (Fletcher, Tardif, Zhi-Xiang, Wei-Lan 2001).

The nature of the linguistic input as well as general cognitive abilities are relevant for the acquisition of word meaning.

Still, in spite of variation, word learning seems to begin at around 12 months and the rate increases in a significant way after the age of approximately 30 months (see Table 1). What exactly leads to this important developmental step? The literature provides several possible answers. According to some researchers, this step should be related to

phonological development. At about 12 months, the child has acquired the relevant phonological knowledge, which enables him/her to detect word boundaries. According to others, children younger than 12 months cannot memorise arbitrary pairs of form and meaning. It is only at around the age of 1 year that their memory allows them to store these arbitrary pairs. Conceptual ability has also been invoked. Children cannot learn words before they are able to understand and to encode the concepts which words refer to. Bloom (2000) relates the beginning of word learning to the development of the theory of mind. According to his hypothesis, children can begin to learn word meanings only after having developed 'enough of an understanding of referential intent to figure out what people are talking about when they use words' (Bloom 2000:46).

1.2 The problem of induction

The task the child faces when trying to hypothesise the meaning of a string of sounds is not an easy one. Firstly, matching the string of sounds with a particular meaning does not have any innate support. Meanings are expressed in various shapes in various languages. Secondly, the linguistic input which they receive only rarely provides explicit information with respect to word meaning, which has to be inferred. Though error correction in the domain of vocabulary may occur on more occasions than in the domain of syntax, it may still be totally absent in some cases.

The linguistic input is deficient in terms of word meaning information.

When hearing an unfamiliar word, the child faces the task of relating it to some content, to a particular meaning. He/she has to choose one hypothesis out of a large set of logically possible hypotheses which match the data. When an adult says "dog" while pointing to a big furry dog which is barking and wagging its tail, how does the child know that the term "dog" refers to the whole animal, and not to its ears or fur or that it does not mean "big" or "furry" or "barking dog"? Also, "dog" could refer to a subordinate kind (Terra Nova, for example) or a superordinate kind ('animal'). All these hypotheses are logically possible. This is what Quine referred to as *the problem of induction*: for any set of data there is an infinite set of logically possible hypotheses consistent with the data. And this is a task which a child faces several times a day, with each and every novel term in the input. In some cases, the number of logically possible hypotheses is smaller (as in the case of concrete nouns, for examples) and observation may be helpful to some extent; but the number of possible hypotheses grows bigger with verbs and abstract terms, where observation is no longer that helpful.

1.3 On observation

How does the young child search within this set and how does he/she choose one single hypothesis, rejecting all the others, at an age when he/she has trouble solving very simple kinds of hypotheses? How does a child solve the problem of induction? The real-world contingencies do not seem to be of much help; on the one hand, they provide too much information (hence the multitude of possible hypotheses) but, on the other hand, they do not provide sufficient information (hence the absence, sometimes, of constraints on the possible hypotheses). This challenges the traditional view which goes back to John Locke and according to which children learn word meanings by noticing the real-world environment in which an unfamiliar word is uttered:

Observation of real-world contingencies is not helpful enough.

> *If we will observe how children learn languages, we will find that, to make them understand what the names of simple ideas or substances stand for,*

> *people ordinarily show them the thing thereof they would have them have the idea; and then repeat to them the name that stands for it, as 'white', 'sweet', 'milk', 'sugar', 'cat', 'dog'*. (John Locke 1690/1964 cited in Gleitman 1990:1).

At first sight, this hypothesis seems to be on the right track. Early vocabularies usually contain words whose meaning can be easily 'guessed' via observation of the environment: *mama, cookie, dog*, and the like. However, words are not always used when their referent can be perceived. Some (abstract) referents can never be 'seen', actually. With verbs, observation seems to be even less helpful, since the time when the verb is uttered may not coincide with the time when the event denoted by the verb takes place.

Also, on such a view, difference in experience should yield differences in the meanings which are acquired. However, studies of the acquisition of vision-related terms (*see, look*) by blind and sighted children (Landau & Gleitman 1985) show that the representations of vision-related terms are similar with the two groups, in spite of the difference in experience. It has also been observed that, in spite of their different perceptual experience, blind children learn words almost as fast as sighted children.

Also, as will be discussed further in this chapter, even extremely simple terms, which belong to every day vocabulary, may encode shades of meaning which are not perceivable to observation alone.

But, if observation is not enough, if the traditional view on lexical acquisition via observation oversimplifies the whole process, failing to account for the acquisition of those terms for which real-world contingencies are not sufficient, how can one account for the fast acquisition of word meanings?

In spite of the difficulty of the task, children can correctly induce meaning and they are able to learn words as rapidly as they acquire grammar. By analogy with morphosyntactic development, one might ask whether lexical development may not be guided by some (possibly) innate principles, ranked one way or another, whose main role is to constrain the number of logically possible hypotheses and thus to help the child to travel through the vast searching space. Maybe children's conceptual systems are guided by some pre-existing expectations, which render their learning task easier. Children's word learning mechanisms have been said to be constrained by various innate assumptions, constraints or biases, some of which are domain-specific, while others may be domain-general. This is in line with the view that lexical knowledge also includes 'knowledge of complex abstract structures that cannot be arrived at through parameter setting, and which must be learned from the data' (Williams 1994:8) and consequently its rich structure cannot result only from an innate linguistic structure but also from a structured learning strategy. One can thus speculate that acquisition of word meaning cannot rely on UG alone. It has to rely on extra-linguistic factors as well:

Vocabulary development is sensitive to the nature of the linguistic input, memory and cognitive abilities, socialising skills, phonological, and morpho-syntactic knowledge.

> *It is not, however, intended that UG should account for all aspects of L1 acquisition. Properties that are specific to a language will have to be learned. These include much of the lexicon: words and their meanings will have to be learned [...].* (White 1989: 30)

It seems that vocabulary development is related to the nature and quantity of the linguistic input which the child receives, on memory and cognitive abilities, socialising skills, attention span, phonological, morphological and syntactic knowledge.

Children can acquire words so rapidly because they are limited in the hypotheses they make by various (innate) constraints.

2. Word learning constraints

2.1 The hypothesis

Children are able to learn words so rapidly because 'they are limited in the kinds of hypotheses they consider' (Markman 1990:155) by some specific constraints, which are present from the onset of acquisition, can be seen as default conditions and can be later abandoned.

Let us see in what way these constraints are assumed to narrow the child's searching space.

2.2 The whole-object assumption

The whole-object assumption (Markman 1990) refers to the child's expectation that a new label refers to a whole object rather than to one of its parts or one of its properties. When a child hears someone utter the word "car", for example, while looking or pointing to the object "car" in the street, he/she will take the string of sounds "car" to denote the whole object, not a wheel or the colour of that object. The kind of individuals which an infant seems to be able to understand at an early stage are physical whole objects. Most of the countable nouns which are present in early vocabularies denote whole objects. For example, Nelson, Hampton and Shaw (1993) show that 67% of the nouns used by 20 month-olds denote (whole) objects.

It is important to mention that the whole-object assumption is operative in non-linguistic domains as well. When asked to count different objects, young children tend to count whole objects in spite of what they are actually asked to do. Shipley and Shepperson (1990) report an experiment in which pre-school children, when shown five forks, one of which broken into two pieces, and asked to count "the forks", the majority answered "six". This proves that domain-general biases may guide children in their understanding of discrete objects as separate individuals, i.e. as whole objects.

The child expects a new label to refer to **a whole object.**

However, there are words which do not refer to whole objects, but to properties (adjectives) or spatial relations (prepositions), or words which refer to groups/collections of objects (*family*, *flock, herd, bundle*) as well as words which denote parts of objects (*surface*). Abstract nouns (*idea, dream)* do not refer to a material entity at all. Mass terms (*milk, coffee, chocolate*) do not refer to whole objects either. In all these cases, the whole-object assumption does not seem to be of much help. Are children able to override the constraint and construe other entities as individuals as well? Experimental evidence shows that they are able to construe entities such as sounds or bounded substances as individuals. There is also evidence that collective nouns such as *family* are present in early vocabularies. This suggests that, in spite of a strong domain-general whole object bias, children are also guided in the acquisition process by other facts, possibly by syntactic cues. The implication would be that in the acquisition of vocabulary domain-general principles and language specific ones intermingle.

2.3 The partonomic assumption

Infants are assumed to determine the extension of basic level categories by attending not only to whole objects but also to parts of objects. According to the so-called

Parts of objects are relevant in category membership decision.

partonomic assumption, parts of objects are given a special status in category membership decision (Poulin-Dubois 1995). Experimental evidence shows that infants are sensitive to the absence of an object part, being able to detect missing part(s) for categories for which they already have a label. Infants aged 12, 15 and 18 months were shown sets of three pictures: one picture represented a 'complete' referent, i.e. a cat, a dog, etc. The other two pictures represented the same referent but with one part removed (i.e. a cat without a tail, a dog without legs, etc.). An adaptation of the preferential looking paradigm was used to test the infants' sensitivity to the absence of a perceptually salient part in word referents. 18 month – olds looked longer at the incomplete referent than at the complete one. No preference could be detected with younger infants, which may suggest that the abstraction of parts develops through language development (Poulin-Dubois 1995).

However, experiments have also revealed that a salient part is not defining at any age. Object parts do not have the status of defining features for young children. When shown object referents (category exemplars) with one part missing children consider them acceptable. Thus, one can say that object parts are involved in the early meaning of words but they do not represent defining features.

2.4 The taxonomic assumption

When hearing a new word, the child will look for **taxonomic relations.**

The taxonomic assumption (Markman 1990) states that children expect a new word to refer to objects of the same kind, ruling out thematic meanings. When a child hears a novel term, he/she will look for taxonomic relations rather than thematic ones, in spite of the fact that, at this early stage, children are extremely interested in the latter type. If the child is taught an unfamiliar word, *bird* for example, when asked to find another *bird*, he/she will tend to choose another bird or bird-like creature, and not a cage or an egg. Single nouns do not encode thematic relations, such as 'a spider and its web'. Markman suggests that the taxonomic constraint may be a consequence of words being generic, unlike phrases. A word like *robber*, she argues, denotes a permanent quality, whereas the phrase *is robbing a bank* does not.

Bloom (1994) suggests that it would be more accurate to say that nouns and verbs – not words – have generic reference, given that there are words which can be phrases (pronouns, proper names). Nouns are generic because they can be used to denote an indefinite number of different objects or portions of substance of the same kind. They refer to kinds. Noun phrases (such as *the big dog*) can be interpreted as denoting one single instantiation of the kind "dog", i.e. an individual or a stage (Carlson 1977). By analogy, a verb like *read* denotes a kind of action, whereas *is reading* refers to an instantiation of the kind of action "read".

Guided by the taxonomic assumption, when children hear a novel word, they will not consider thematic relations as possible candidates for the meaning associated with that particular new label. They will tend to categorise it as referring to other objects of the same kind.

But there are words like pronouns or proper names, which are among the first to appear in early vocabularies as referring to unique individuals (Sorrentino 1999) and which do not generalise to other entities, i.e. which do not refer to taxonomies (Bloom 1994). How do children learn these words? The taxonomic constraint cannot help them in this case. One possible solution proposed in the literature is that young children are guided by an animacy bias in their construal of proper name reference. This bias may, however, be a reflection of the frequency with which proper names in the input are used for people and animals. Experimental evidence has shown that the animacy bias is not an absolute constraint and that, with proper names too, children use a set of cues

(semantic, pragmatic and proper name syntax information) to infer that a word refers to a proper name (Sorrentino 1999).

2.5 The mutual exclusivity assumption

The mutual exclusivity assumption **(**Markman 1990) or **the principle of contrast** (Clark 1983)[1] refers to the child's expectation that a new term should refer to an object for which they do not have a label yet. The novel term will not be interpreted as a complete synonym. For example, if you show a child a flower and call it *yellow*, the child will not interpret the novel term as denoting the "flower" if he/she already has a label for that object, but will probably interpret it as denoting a salient property of the object.

A novel term is assumed to refer to an object for which the child has no label yet.

Pinker (1994a) reports of an experiment in which children were taught a nonsense word – *biff* – for a pair of pewter tongs. In this case, the child, who does not know any other label for the object "tongs" will take *biff* to refer to the whole object, as the whole-object constraint guides him/her to do. But if you show a child a pewter cup and call it *biff*, the child, who already knows a label for "cup", will interpret *biff* to refer to a salient property of the object, most probably substance. When required to find more *biffs*, the child will look for more pewter objects and not for more cups.

2.6 Conventionality

Children know, from very early on, that different forms have different meanings, and that each label stands for one concept. And they also know that this relation is arbitrary[2]. Conventionality is assumed to be one of the pragmatic principles which constrain the options children have to consider when hearing novel terms (Clark 1991). They know that language is conventional, that words are shared symbols and that, for a certain meaning, speakers in a certain community expect a particular form to be used. From the onset of acquisition they elicit conventional words by constantly asking *What is this/that?*.

The child knows that words are used in a **conventiona l** way.

Conventionality and contrast work together with the same aim as the one assumed for the mutual exclusivity assumption:

> *This consequence of conventionality and contrast together can be expressed as the principle of pre-emption by synonymy: "If a potential innovation would be precisely synonymous with a well-established term, the innovative term is normally pre-empted by the well-established one, and is therefore considered unacceptable"* (Clark 1991:35).

One question raises at this point: if children always observe the mutual exclusivity assumption or the principle of pre-emption by synonymy, how can they learn labels for an object in a second language?

Experimental studies on both monolingual and bilingual children (Au & Glusman 1990, DeWitt 1995) show that pre-school children are able to suspend this assumption when needed. This allows them to accept different labels for one and the same object when the labels belong to two different languages.

With the mutual exclusivity assumption it is more obvious than with other constraints that it has to be suspended at least at a later stage. If this principle were never suspended, one could not account for how children manage to learn names for particular individuals or synonyms, for example. It seems that either children know when they have to observe and when they have to suspend this assumption or that it is operative only

[1]The mutual exclusivity assumption is related to Slobin's (1973) Principle of one-to-one mapping and to Pinker's (1984) Uniqueness Principle.

[2] Before turning 2, ASL-speaking children and English-speaking children make the same error when using *you* and *me*. This demonstrates that the arbitrariness of the relation between a symbol and its meaning is deeply entrenched in the child's mind (Pinker 1994a).

during early stages of linguistic development. As they get older, they become aware that the mutual exclusivity assumption can be restricted in some domains and given up in others.

2.7 Simplicity of form, transparency of meaning and frequency

Young learners also show a bias towards simple forms, transparent meanings and frequently used options especially when creating new words (Clark 1991). Thus, **simplicity**, **transparency of meaning** and **frequency** represent further constraints operative in the domain of lexical learning and early compound formation[3]. When the child must choose between forms he/she will choose the simplest ones, which he/she already knows, i.e. which are transparent to him/her. And when he/she has to choose between forms which are equally simple or equally transparent he/she seems to have a bias towards the most productive of the options available, i.e. those word-formation procedures which are the most frequently ones used by adults and which are more frequent in the linguistic input that the child receives.

The child tends to choose the **simplest, the most transparent** and **the most frequently** used words.

2.8 The shape-bias

Children resort to **shape** similarity in order to map novel terms onto basic level categories.

Perceptual information about the object/substance status of the object denoted by a noun has also been proved to be important for the initial mappings between objects and countable nouns, and between substances and mass nouns, respectively (Subrahmanyam and Landau 1995). A bias that seems to be guiding the acquisition of word meaning (possibly even initially overriding the syntactic context) is the so-called **shape bias**. Children seem to tend to map new nouns onto basic–level categories by resorting to shape similarity:

> *The early shape bias in word learning invites children to form categories of perceptually similar things. Because members of the same taxonomic category tend to look alike in the real world, these shape-based categories will often be good approximations of theory-based ontological categories* (Imai and Gentner 1995:175)

For example, when taught new countable nouns that denote objects, children will generalise these nouns on the basis of shape (Landau et al. 1988). The shape bias seems to be stronger with younger children and to get weaker with older children and adults who attend more to the syntactic context.

The shape bias has been said to precede the taxonomic assumption: children extend noun meaning on the basis of shape at an early age and, only later, after further learning occurs, do they shift to extension of meaning on taxonomic assumptions (Imai and Gentner 1995).

2.9 The type-of-substance bias

The type of substance denoted by the novel noun is relevant for acquisition.

It has also been claimed that children are guided in the acquisition of noun meanings by the type of substance denoted by the noun. Soja et al. (1991) point out that children

[3] See Chapter 3 for details.

follow two procedures in the acquisition of noun meanings according to whether the noun denotes **a solid or a non-solid substance**:

Procedure 1:
Step 1: Test to see if the speaker could be talking about a solid object; if yes,
Step 2: Conclude that the word refers to individual whole objects of the same type as the referent.

Procedure 2:
Step 1: Test to see if the speaker could be talking about a non-solid substance; if yes,
Step 2: Conclude that the word refers to portions of substance of the same type as the referent.

2.10 Word learning constraints are not (always) language specific

(Some) word learning constraints are not language specific.

As can be seen, the principles invoked in relation to the acquisition of word meaning are not always language specific. Children are assumed to rely on some extra-linguistic facts (pragmatics, knowledge of the world, underlying conceptual and perceptual categories) in their attempt at improving their vocabularies.

One should however point out that a different point of view has been put forth in the literature, according to which such constraints would be too "strong", at least for the early stages of word learning, during which many lexical items are unstable or /and do not have the adult meaning (Nelson 1988, Dromi 1993). On such a view, the young child cannot take words to refer to kinds of objects, individual objects or portions of stuff from the onset of acquisition. In the beginning, word meanings are assumed to be salient perceptual features of what the child believes the referent of the word is. Only after the so-called vocabulary spurt (Nelson 1988) or after the child has learned the syntax of quantification (Quine 1960) could the young child distinguish between kinds of objects, individuals or portions of stuff.

But there are experimental results which suggest that this point of view encounters a few problems. Carey (1993) provides evidence that the ontological status of the referent is relevant for early vocabulary learning (24 months) and that children can induce the ontological distinction between objects and substances before having learned the syntax of quantifiers, plurals or determiners. In Xu et al. (1995) it is argued that 12-month-olds can already make a distinction between kinds and properties before they begin to acquire countable nouns.

Other researchers emphasise the fact that these learning constraints are mere by-products of children's non-linguistic conceptual biases and hence should not be posited as principles specific to word learning. Bloom (1994:306) argues that the constraints which actually guide lexical learning 'emerge from other properties of children's knowledge: in particular, from children's grasp of syntax-semantics mappings', which play a crucial role in lexical development. Any other type of constraint, though relevant for acquisition, is not language specific:

> *By rejecting the idea of special constraints, I am not denying that young children know a lot about words – about their phonology, morphology, syntax, and meaning – and that this knowledge can facilitate the learning of language [...] and that some of it may be innate. The proposal I am arguing against is that there exist additional constraints of the sort proposed by Markman and others,*

constraints whose sole role is to facilitate the process of word learning. (Bloom 2000:11)

Suppose it is true beyond doubt that these constraints, in spite of not being language specific, play an important part in the acquisition of word meaning. The view that lexical development may involve domain-general mechanisms besides language specific ones has already been advanced. But most of the constraints discussed so far refer to the acquisition of nouns. The question is: do children make similar assumptions when learning verb meanings or pronouns and proper names? Early vocabularies also contain words which refer to locations, events, temporal entities. What constraints are available in this case? Can we say that these principles constrain the acquisition of word meaning in general or only the acquisition of nouns?

3. Vocabulary acquisition and theory of mind

Bloom (2000) proposes that the most important element in the process of word learning is the child's understanding of the (referential) intentions of others, i.e. on their theory of mind:

> *[...] some capacity to understand the minds of others may be present in babies before they begin to speak. There are many names for this capacity, including mind-reading, social cognition, and pragmatic understanding, but [...] I use the term theory of mind* (Bloom 2000: 61).

In this, he follows some of the earliest attempts at explaining word learning, such as the one in *The Confessions of Saint Augustine* (398):

> *When [my elders] named any thing, and as they spoke turned towards it, I saw and remembered that they called what they would point out by the name they uttered. And that they meant this thing and no other was plain from the motion of their body, the natural language, as it were, of all nations, expressed by the countenance, glances of the eye, gestures of the limbs, and tones of the voice, indicating the affections of the mind, as it pursues, possesses, rejects, or shuns. And thus by constantly hearing words, as they occurred in various sentences, I collected gradually for what they stood; and having broken in my mouth to these signs, I thereby gave utterance to my will.* (cited in Bloom 2000:61)

Word learning is a type of intentional inference.

According to Bloom, the child's ability to read the mind of the 'interlocutor' underlies his/her learning not only of the meaning of words but also of how words relate to each other and of how they can be used in communication. Word learning is defined as 'a species of intentional inference' (p. 61). The young child needs to see the speaker and what he/she is looking at in order to be able to infer the meaning of words.

Evidence in favour of this hypothesis comes from experimental data. 18 month old infants were placed in a context in which they played with one object, while a different object was placed in front of the experimenter, in a bucket (Baldwin 1991, 1993 reported in Bloom 2000). The experimenter looked at the object in the bucket and uttered a new word, *moni*, while the child was playing with the other object. When asked to point to the *moni*, the children chose the object in the bucket and not the one they were playing with. When young children were placed in a room, alone, with a new object, they did not relate the string of sounds *Dawnoo! There's a dawnoo!*, uttered by an

impersonal voice, to the new object. Such data suggest that children rely on the referential intention of the interlocutor (which plays the part of a cue) in order to learn word meaning, and not on observation of the object alone.

Further evidence in favour of this view comes from studies of two radically different types of impairment: autism and Williams syndrome. The cause of autism is related, according to one hypothesis, to a delayed, impaired or missing theory of mind. Autistic individuals cannot socialise or communicate with the others. The majority have limited language skills. Pronominal reversal, the use of 'I' for 'you' and vice-versa, seems to be rather frequent. When they hypothesise the meaning of words, they mainly rely on associative learning mechanisms. For example, Bloom reports the case of an autistic boy who used 'Peter eater' when talking about saucepans. This was taken to be due to the fact that, when he was about 2, his mother dropped a saucepan while reciting him 'Peter, Peter, Pumpkin Eater'. Another cited case is the one of an autistic child who used the word 'sausage' to refer to toy trucks, presumably because his mother had told him 'Come and eat your sausage' while he was looking at his truck.

Williams syndrome individuals, on the other hand, are highly social. In spite of their mental retardation, their language ability is relatively spared and, in the domain of vocabulary, it may even surpass that of normal individuals of the same age. This contrast between the two types of impaired individuals shows how important social capacities and ability to guess the communicative intentions of others can be.

4. The acquisition of nouns vs. the acquisition of verbs

4.1 Are nouns easier to learn?

There is evidence, both theoretical and experimental, that verbs are more difficult to learn than nouns or, at least, than non-abstract nouns. This could explain why nouns seem to be predominant in children's early vocabularies, as can be seen in Table 2 (taken from Goldfield 1998:281), which summarises the results of various studies related to the early emergence of (common) nouns and verbs:

Table 2

Proportion of nouns and verbs in the early lexicon

Diary Studies	Common nouns	Verbs/Action words
Nelson (1973)	.51	.13
Benedict (1979)	.50	.19
Goldfield (1986)	.48	.16
MacArthur Communicative Development Inventory	.63	.08

It has been suggested that noun meanings are easier to hypothesise because they can be often inferred by pairing a string of sounds with an object or an individual by sheer observation of the extra-linguistic situation, whereas actions seem more difficult to identify. Terms for actions are always relational in meaning, they link one or more participants to the event (Gentner 1982, Clark 1991). Maybe that is the reason why they can almost never occur in ostensive definitions. We often say "This is a book" or "This is water", but we hardly ever say "This is reading" or "This is

Nouns are predominant in early vocabularies because noun meanings are easier to infer than verb meanings.

eating". Even when we say 'Look, he's eating!' the hypothesis space is much larger than when we say 'Look, this is a flower'.

Actions have vaguer boundaries and quite often the verb is heard before or after the action takes place. For example, the child can hear an utterance like "I will give you something to eat" before the action actually takes place. Ambalu, Chiat and Pring (1997) studied the effects of verb input on the acquisition of verb meaning on 30 children aged 2; 3 to 3; 6. Interestingly, the findings of their experiment show that verbs which describe movement can be better learned when heard before the event has taken place, whereas verbs which focus on the result are better learned if the child hears the unfamiliar word after the action has taken place.

Also, some very simple verbs, used in every day conversation, and which denote perceivable events, may encode perspectives and beliefs which cannot be inferred by mere observation; some semantic components (causation, manner of action, etc.) are conflated into the meaning of the verb. Consider, for example, pairs of verbs such as *buy/sell, win/beat, give/receive* (Gleitman 1990). How can the child detect the change of perspective while watching a buying-selling scene, for example? There are also verbs which denote states of affairs which cannot be observed at all, such as *think, believe, want, wonder, guess, understand.* And these verbs are used by parents quite a lot when talking to their children.

The conclusion we can reach so far is that the meaning of at least some classes of verbs is even more difficult to hypothesise by mere observation than the meaning of nouns. And there is experimental evidence that indeed verb meaning is more difficult to infer than noun meaning. Gillette and Gleitman (1995) devised an experiment in which adults' ability to infer verb meaning by observation was tested. The subjects were shown short videotapes of mothers playing with their infants, with the audio turned off. Whenever the mother uttered a noun, a beep was heard and the subjects were required to guess what noun had been uttered. About 50% of the guesses were accurate at the first beep, but the results improved for later beeps. In a second experiment, the subjects watched videotapes, as in the first experiment, but this time a beep was heard every time the mother had uttered a verb. The subjects managed to guess the right verb only 7% of the time.

By analogy, Gleitman and Gillette conclude that it must be more difficult for children to infer verb meaning than noun meaning. This hypothesis is also supported by the fact that early vocabularies (the first 50 words) often contain no verbs and the number of verbs continues to be smaller than that of nouns until around age 3. This fact is more intriguing as these early vocabularies do not contain only nouns which denote basic-level classes of objects (which could be learned by observation) but also nouns which refer to locations, events or temporal entities, i.e. which can hardly be learned by mere observation. This suggests that verbs are not more difficult to learn only because their meaning cannot always be inferred by resorting to the extra-linguistic environment but for some other reasons as well which may be linked to the complexity of their structure. If this is the case, the obvious question is: how do children cope with verb meaning in the end? Are they constrained in their hypotheses by some general principles? Are these principles the same as the ones which guide the learning of noun meaning?

4.2 Word learning constraints and the acquisition of verbs

The same constraints apply in the acquisition of both nouns and verbs.

Clark (1991) argues that the constraints which guide the child in the hypothesis space of noun meaning will also apply to the acquisition of verb meaning. The whole-

action assumption will tell the child that a novel term denoting an action refers to the act that links the different participants in that event as a whole. The generic-level assumption relates to the expectation that words (nouns or verbs) denote categories which are distinct from each other, but whose members share a maximum number of properties. The equal-detail assumption also applies, according to Clark, in the learning of both noun and verb meanings. The child somehow knows that each word denotes equally detailed instances of categories.

However, this does not seem to be enough. Even if one adopted the view that these constraints are sufficient to guide the child through the maze of hypotheses, they still cannot explain why children are slower to learn verbs than nouns. Nor can they explain how children acquire pronouns or proper names.

Nouns and verbs are acquired differently.

Fisher et al. (1994) advance a different point of view. According to them, nouns and verbs are actually acquired in different ways: when learning a novel noun, the child must map a word to the world, whereas when learning a new verb, he/she must map a sentence to the world. This sentence-to-world mapping could explain why early vocabularies contain few verbs (if at all); noun meanings can be learned in the absence of structural knowledge, but verbs cannot.

4.3 Input and lexical development

The predominance of nouns in early vocabularies may be the result of the linguistic input.

The input has also been invoked as a possible cause of the predominance of nouns or verbs in early vocabularies. The predominance of nouns in early vocabularies has been said to be the result of the linguistic input which children receive at this stage, and which provides more evidence for the meanings of nouns than for the meanings of verbs (Snedeker and Gleitman 1999). On such an account, it is not relevant to stress the difficulty of inferring the meaning of verbs and as such to try and link the lack of verbs in early vocabularies to the cognitive limitations of young learners. Certain properties of the input are responsible for the predominance of nouns in early vocabularies. This view predicts that the way in which children cope with nouns vs. verbs, being dependent on properties of the input, may differ from one language to another.

The predominance of nouns in early vocabularies may be due to the morphological variation available in the input.

This prediction is borne out by data from child Mandarin Chinese and Korean. Mandarin-speaking children produce more verbs than nouns in their early vocabularies. Tardif (1995) accounts for this phenomenon by resorting to a comparison of the percentage of nouns and that of verbs in the subjects' speech and in the input which they received. Similarities between the percentage of nouns and verbs in the input provided by adults and in the early speech of Mandarin-speaking children have been found.

Choi and Gopnik (1995) report an early verb-bias in child Korean that they also attribute to certain properties of the input. But, even with Korean children, there is a noun bias in the first 50 words.

One more possible explanation for the early predominance of verbs or nouns may be one which takes into account the morphological variation (i.e. the number of forms used for one and the same word) available in the input. Yamashita (1999) argues that Japanese children acquire nouns earlier because nouns have the least variation in the linguistic input, whereas verbs are acquired late due to the fact that they have the most morphological variation.

Such findings lead to the conclusion that the noun bias or the verb bias in early speech may be language dependent and not universal as previously claimed (Gentner 1982, Nelson 1973). This conclusion is supported by a study of the early lexical acquisition of four Mandarin Chinese-English blilinguals (Nicoladis 2001),

aged; 7 – 2; 0. In spite of the fact that all the children knew more nouns than verbs in both English and Chinese, the children with larger Chinese vocabularies used more verbs than nouns in Chinese and more nouns than verbs in English.

4.4 Conclusions so far

So far, we have seen that the following explanations for the predominance of nouns or of verbs in early vocabularies have been put forth:

(i) nouns emerge earlier because they are more 'accessible' to children, their meaning is easier to identify;
(ii) certain properties of the input (such as frequency of nouns) are responsible for an early noun-bias or an early verb-bias;
(iii) language specific properties, such as morphological variation can explain why nouns are acquired faster than verbs.

There is evidence in favour of all these hypotheses, which suggests that multiple factors may be involved in lexical acquisition (Tardif, Shatz and Naigles 1997, Yamashita 1999) and also that input plays a more important part in the process of lexical development than it does in the process of syntactic development.

5. Syntax-guided or semantics-guided learning of word meaning?

5.1. The question

In the late 60s and early 70s, a debate began concerning the way in which children learn the meaning of words and their syntactic properties. At the very core of the debate, in which the acquisition of verb meaning had a central part, was the question: "What comes first: syntax or semantics?" i.e. "Do young children analyse their words in semantic or syntactic categories, do they rely on the syntactic categorisation or on the semantic properties of words?" This question received two different answers:

(i) Syntax helps lexical learning. Young children are imposing syntactic categories on words at a very early stage and syntactic environment is crucial for lexical development. On this view, which has been known in the literature as the **syntactic bootstrapping** hypothesis, children rely on syntactic categorisation to learn the meaning of words.
(ii) Semantics helps lexical learning. On this view, known as the **semantic bootstrapping** hypothesis, children infer the meanings of words from the observation of events, without grammatical information. Acquisition of syntax requires prior knowledge of word meanings.

The views in (i) and (ii) can be reconciled. On this **reconciliation** view, a hypothesised meaning based on observation is seen as the input to linguistic mapping principles.

Let us see how each of these approaches deals with the complexity of the acquisition of word meaning.

5.2. The syntactic bootstrapping hypothesis

5.2.1. The role of the linguistic context

Learners are sensitive to the formal properties of language; they expect to find a link between these properties and semantic interpretation. In order to infer the meaning of a word, the child is assumed to rely on the syntactic context in which the word is used, i.e. its syntactic frame. The child can predict the meaning(s) of the verb by analysing the argument structure with which it has been used in a sentence.

As early as 1957, Brown demonstrated that the acquisition of vocabulary could get help from the linguistic context in which the particular word is uttered. When 3- to 5-year olds are shown sets of pictures depicting one an object and the other one a substance, they will tend to point to the picture depicting the object when required to show *a sib,* but to the one depicting the substance when required to show *sib*. There are morphological cues which help the child to label the word with an object or an activity. When hearing a nonsense word like *the gorp*, children tend to point to an object, but when they hear *gorping* they tend to point to the implied action. Such experimental evidence led linguists to look for different cues in the linguistic context which could help the child to map the label with the appropriate intended meaning (Landau & Gleitman 1985, Naigles 1990, Gleitman & Gillette 1995 among others). The hypothesis which they advance is that children rely on syntactic information to learn new words:

Syntactic bootstrapping: children use syntactic information to learn word meaning.

> *... the range of subcategorization frames has considerable potential for partitioning the verb set semantically, and [...] language learners have the capacity and inclination to recruit this information source to redress the insufficiencies of observation. This examination of structure as the basis for deducing the meaning is the procedure we have called syntactic bootstrapping* (Gleitman 1990:27).

For example, when hearing the sentence *He gorped the apple*, the child can infer that *gorp* denotes an action which implies an agent and a physical object relying on the syntactic frame in which the verb has been used: a transitive one. When hearing *I gorped the apple from the basket* the child will hypothesise that *gorp* also involves a direction. If *gorp* is followed by a clausal complement, as in *I gorped that he did not like the apple*, the child will infer that the verb may denote some kind of mental activity.

The proposal is not as radical as it might look at first sight; it does not imply that syntactic information alone helps the child to map the word with its intended meaning. It simply argues that syntactic information plays an important part in the acquisition of vocabulary, without denying the part of observation:

> *The input is seen as consisting of both the extralinguistic event, observed by the child, and the linguistic event, which provides a verb used in a certain grammatical environment* (Gleitman 1990).

Consider, for example, the pairs of sentences below:

(1) a. *John melted the ice.*
b. *The ice melted.*

(2) a. *She cooled the soup.*
b. *The soup cooled.*

In both (1) and (2) the same verb describes an accomplishment in **a** (i.e. a telic predication which crucially involves causation) and an achievement in b (i.e. a predication which is telic, just like the one in **a**, but which involves only a change of state; no causation is at stake in this case). The situation which sentence **a** describes can be equally described by the **b** sentence. There is no possibility to infer the correct meaning of the verb in **a** and **b** on the basis of the analysis of the event. How does the child cope with such situations, then? The crucial assumption is that it is the linguistic input, i.e. the subcategorization frame in which the verb appears which guides the child. In the **a** sentences, the verb occurs in a transitive construction whereas in the **b** ones, in an intransitive frame. These syntactic properties are than mapped onto the meaning of the verb.

Children are able to notice the systematic relations which exist between verb meaning and sentence structure. Noticing these regularities helps the child to reduce the hypothesis space, to narrow down the set of logically possible hypotheses with regard to the meaning of an unfamiliar word. For example, when a child hears a nonsense verb like *gorp* in a sentence like *John gorps*, it is more likely that he/she will interpret the novel verb to mean "smile" rather than "hit". When hearing *John gorps Bill*, the reverse will happen. The frame in which the verb occurs provides information about the number of arguments, the type of arguments, the choice of agent or affected entity when more than one is possible, i.e. the type of information impossible to infer from mere observation of the extra-linguistic situation in which the verb is used.

The part of the frame in the learning of word meaning seems to be so important that it can even make the young learner change the meaning of a familiar verb to make it conform to the new frame in which it was encountered. Naigles, Gleitman and Gleitman (1992) tested the role of frames in the lexical development of 2-, 3- and 4 year olds. In the experiment, familiar transitive verbs, such as *bring*, were used intransitively (as in 3) and intransitive familiar verbs, such as *come*, transitively (4):

(3) **The zebra brings.*
(4) **The elephant comes the giraffe.*

The subjects were required to act these sentences. The results of the experiment show that the children tried to act them in accord with the frame, thus changing their previously acquired meaning.

5.2.2. Regularities between syntax and semantics

Linguists have noticed that there often exists a certain relationship between the meaning of words and their syntactic properties; words which systematically differ in terms of meaning also differ in terms of the syntactic environment in which they occur. For example, nouns which denote objects tend to be countable (*dog, cat, book*) but nouns which denote substances tend to be mass nouns (*water, milk, juice*). This systematicity could be explained by the fact that objects have boundaries, and hence can be counted, whereas substances describe homogeneous wholes, which do not have boundaries or whose boundaries are vague and, consequently, cannot be counted. This systematic difference in meaning is mapped by a systematic countable/mass syntactic difference.

One can extend this view to the domain of predicates. It has been noticed that predicates denoting states tend to behave like mass terms, they cannot be counted; they denote homogeneous states of affairs, on a par with mass terms (Mourelatos 1986). Change of state predicates, on the other hand, tend to behave like countable nouns, they can describe different instantiations of the same kind of event. This semantic difference is reflected by the incompatibility and, respectively, compatibility with the progressive.

Studies of various classes of verbs revealed that verbs which take prepositional objects whose prepositions indicate direction, such as *across, along, away from, to, towards*, usually denote eventive predicates rather than statives. Verbs which take sentential complements tend to denote mental states rather than physical ones[4]. Verbs which can be used in the imperative tend to denote an action which can be controlled by the subject of the sentence, a.s.o.

One should not, however, reach the conclusion that there is always a systematic syntax/semantics mapping cross-linguistically and that similar semantic facts do always result in similar syntactic configurations. One obvious example is that of the modal verbs. In spite of the fact that they denote the same notions, they do not behave similarly cross-linguistically. In English, for example, the class of the so-called modal verbs behave more like functional categories, representing a distinct morpho-syntactic class, whereas in Romance languages like Italian, Spanish or Romanian, they behave like lexical verbs. Also, in English, the verbs *donate* and *give*, in spite of the similarity of the event which they denote, differ in terms of syntactic frame.

Children are able to exploit syntax-semantics regularities.

5.2.3. How children exploit these regularities

There is experimental evidence that children can detect and use these syntax-semantics regularities in the acquisition of vocabulary, both in the domain of nouns and in the domain of verbs.

Bowerman (1983) noticed that her children would occasionally use, in spontaneous speech, innovative causative constructions of the type:

(5) *I'm gonna fall this on her.*

In (5), the verb *fall* has been used as *cause to fall*. Such constructions show that children are aware of the transitive-causative relation, which they can make use of in a creative way.

Naigles (1990) used the preferential-looking paradigm[5] to investigate whether children (aged between 1; 11 – 2; 3) can use syntactic structure in hypothesising verb meanings in their interpretation of unfamiliar verbs. The child was seated on the mother's lap and observed pairs of events, simultaneously presented on two video monitors. The children were then shown a multiple scene, with two actions going on simultaneously, performed by the same actors. One action was causative and the other one non-causative. For example, the children were shown a multiple scene in which a duck was forcing a rabbit to stay in a bending position (the causative action) and, at the same time,

[4] See Levin (1993) for more examples.

[5] The preferential looking paradigm is a comprehension test during which the child is required to look at one of two simultaneously presented video events while hearing a sentence which describes one of the events. His/her preference of looking longer at one event is taken as indicative of how he/she has interpreted the sentence.

the duck and the rabbit were making arm gestures (the non-causative action). Some children heard a novel nonsense verb in a transitive frame – *Look! The duck is gorping the bunny.* The other children heard the new (nonsense) verb in an intransitive frame – Look*, the duck and the bunny are gorping.* Then, one single action scenes appeared again: on one monitor, the causative action could be seen and on the other one the non-causative event. The child was asked: *Where's gorping? Find gorping now!* The children who had heard the novel verb in the intransitive frame focused significantly longer on the monitor presenting the non-causative event. The children who had heard the verb in a transitive construction looked longer at the monitor which presented the causative event. The findings clearly support the view that the structure of the sentence represents an important source of information for verb learners.

Fisher et al. (1994) tested how children can detect the distinction between pairs of perspective-changing verbs (of the type *give/receive, chase/flee, lead/follow*) on the basis of observation and syntactic deduction.

The hypothesis they started from was that children watching a scene showing, for example, a rabbit giving a ball to an elephant and hearing a new verb describing the scene, will interpret its meaning according to the frame in which the verb was first heard. The experimental method they used was the paraphrase method. The children (24 3-year- olds and 30 4-year-olds) were shown six brief videotaped scenes, described by the experimenter with a sentence that contained a nonsense verb. The subject was then asked to paraphrase that verb. Each scene contained puppet actions, which could be described by two English verbs that differed both semantically and syntactically. For example, in one of the scenes, an elephant hands a ball to a rabbit. The children were divided into groups and each group heard one of the three descriptions:

(6) a. *Look, biffing!*
b. *The rabbit is biffing the ball to the elephant.*
c. *The elephant is biffing the ball from the rabbit.*

It is interesting to point out that 29% of the trials for 3-year-olds and 23% for 4-year-olds represented failures. In spite of the fact that children could observe the event and were provided a description of the on-going event, they still failed to infer the meaning. In some cases, when children were introduced the verb in the (a) frame, they mentioned both possible paraphrases. Also children showed a clear agent bias in the interpretation linked to (a). They did not randomly choose a *give*-like or a *receive*-like paraphrase, as one might have expected, but they tended to choose the *give*-like verb, i.e. the agentive one. With (b) and (c) the results clearly showed that the syntactic frame had an effect on the acquisition of the new verb. The children chose, in a principled way, a *give*-like or a *receive*-like paraphrase, according to the syntactic frame in which they were taught the verb.

All these findings provide convincing evidence that structural clues are helpful; children are able to detect syntactic cues and to exploit them in order to hypothesise the intended meaning of the novel word.

5.2.4 Multiple frames

We have seen that there is experimental evidence that children can detect and use syntactic information in order to infer word meaning. The learner is assumed to "zoom in" on the most salient interpretation(s) of the extra-linguistic situation by exploiting the structural information provided by the linguistic input. This is what has been called "the zoom lens

hypothesis" (Gleitman and Gillette 1995, Fisher et al. 1994 a.o.). But, in some cases, the interpretation of the verb meaning may be impossible on the basis of one single pairing sentence (syntactic structure) – extra-linguistic information. There are cases when such a pairing can be misleading. The example which is usually provided to support this idea is that of the sentences (a) and (b) below, which frequently occur in adult-child dialogues:

(7) a. *Did you **eat** a cookie?*
b. *Do you **want** a cookie?*

One single syntactic frame is not always enough to hypothesise the right meaning. Children may guess *eat* instead of *want* in the case of (b), for example.

A similar situation may arise in the case of the misleading pairing in (8) below:

(8) A. *Ed **gave** the horse to Sally.*
b. Ed ***explained** the facts to Sally.*

Both *give* and *explain* describe transfer of entities between two parties and they can appear in the same syntactic construction: NP1 VP NP2 *to* NP3. But *explain* denotes mental transfer and accepts sentential complements (as in 9) whereas *give* denotes physical transfer, and is incompatible with sentential complements (10):

In order to infer the meaning of a verb the child has to examine all the syntactic frames in which it occurs.

(9) Ed *explained that there was an elephant in the kitchen.*
(10) **Ed gave that there was an elephant in the kitchen.*

The young learner will be able to detect the difference (physical vs. mental transfer) only after having heard the two verbs in both syntactic environments.

The hypothesis put forth is that the mapping problem can be solved by multiple frame information; it is only by examination of all (or several of) the syntactic contexts in which verbs occur, i.e. of multiple syntactic frames, that the children will be able to make out the appropriate meaning.

Evidence in favour of the multiple frame hypothesis comes from the analysis of the role of maternal input on the learning of word meaning. It seems that the diversity of syntactic frames in which verbs appear in maternal speech can predict the frequency with which these verbs appear in child speech later (Naigles, Hoff and Ginsberg 1993).

Multiple-frame information enhances the possibility of correctly hypothesising word meaning with adults as well. Experiments show that they can better infer verb meaning when provided with frame-range information. This shows that verb frames can have semantic implications. Scene information is quite uninformative without frame ranging. What the child actually needs are multiple paired scenes and sentences:

> *... the set of syntactic formats for a verb provides crucial cues to the verb meanings just because these formats are abstract surface reflexes of the meanings...the set of subcategorization frames associated with a verb is highly informative about the meaning it conveys. In fact, since the surface forms are the carriers of critical semantic information, the construal of verbs is partly indeterminant without the subcategorization information. Hence, in the end, a successful learning procedure for verb meaning must recruit information from inspection of the many grammatical formats in which each verb participates* (Landau & Gleitman 1985:138–139).

5.2.5 From verbs to nouns

The arguments which have been discussed so far in defence of syntactic bootstrapping belong to the verbal domain. Actually, one of the assumptions we started from was that verb meaning is more difficult to infer than the meaning of nouns because the structure of verbs is more complex. Does this mean that syntactic cues are not relevant with nouns? Are they less relevant? There is experimental evidence that syntax also helps children to infer the precise noun meaning. Syntactic cues are important in the acquisition of nouns as well.

Bloom and Kelemen (1995) show that children can detect the correct collective noun meaning on the basis of syntactic cues. They tested this hypothesis on 16 adults and 16 4- and 5-year olds. Each subject was first shown pictures of novel objects, described as either "These are fendles" or "This is a fendle". The subjects in the plural condition were expected to treat the word "fendle" as an object name and the subjects in the singular condition were expected to treat "fendle" as a collective noun. After the new word was taught, each subject was shown sets of two pictures, one depicting a single object and one a collection of objects, and asked: "Can you show me the fendle?" If "fendle" was assumed to be a collective noun, the subject was expected to point to the picture depicting a collection of objects. If the word was assumed to be an object name, the subject should have pointed to the picture depicting the individual object. The results revealed that the children were sensitive to syntax[6]. The ones in the singular condition favoured the collective interpretation and the ones in the plural condition the object name interpretation.

Bloom (1994) reports another experiment designed to test if children can detect the syntax-semantic mapping in the case of mass/countable nouns. 3- and 4 year olds were taught novel nouns denoting ambiguous stimuli, i.e. stimuli which could be interpreted either as a set of individuals or as an unindividuated portion, such as spaghetti or lentils, or a string of bell sounds from a tape recorder. The children were divided into two groups. One group was introduced the novel term in a countable frame, e.g. *These are feps – there really are a lot of feps here*. The other group heard the new noun in a mass frame, e.g. *This is fep. There really is a lot of fep here.* Then the children in the first group were asked to "give the puppet a fep". Most of them tried to give the puppet an object. The children in the "mass" group were required to "give the puppet fep". They tended to give the puppet a handful of objects.

These findings show that chidren are aware of the syntax-semantics mappings. And it seems that these mappings help them to infer the meaning of nouns as well as the meaning of verbs.

5.2.6 Conclusions so far

The discussion so far has shown that the syntactic bootstrapping hypothesis proposes a trajectory of lexical development within which the child has to rely on the analysis of (multiple) syntactic frames. The role of observation is not denied, it is only argued that, in many cases, observation of situational contexts alone is not enough. The assumption is that observable properties of sentences are more relevant for the acquisition of meaning. Syntax is a relevant source of information, i.e. children can infer word meanings from word syntax. But, besides syntax, a set of other learning mechanisms are taken to complement each other, among which observational learning.

[6] Adults answered correctly 100%. Bloom and Kelemen (1995) also report that there exists a tendency to produce "collective N" responses to *This is a fendle* as subjects get older. The older the subject the more sensitive to the effect of syntax (s)he seems to be.

From the point of view of linguistic theory, syntactic bootstrapping assumes that there exist syntax/semantics mappings. The child will infer the correct semantics guided by the syntax which provides helpful information. Semantics is assumed to be read off the syntactic structure.

5.3 The semantic bootstrapping hypothesis

5.3.1 Arguments against the syntactic bootstrapping hypothesis

Critics of the syntactic bootstrapping hypothesis disagree that the syntactic frame of the verb can play such an important part in word meaning learning. According to them, a child can infer the meaning of a new verb not by resorting to the analysis of the syntactic frame in which it occurs but because he/she knows the meaning of the other words in the sentence. For example, when hearing a sentence like *I gorped the cake and now I am full* the child will infer that *gorp* means something like *eat* because he/she knows what *cake* and *full* mean and also relying on a partial analysis of what links the words together (Pinker 1994b). What guides the child, according to this view, is a kind of 'cognitive inference using knowledge of real-world contingencies' (Pinker 1994b: 382). Notice that, even according to this view, the role of syntactic analysis (be it only 'partial') is not denied.

It has also been pointed out that there are cases when a particular syntactic frame in which a verb occurs may not be informative enough. For example, arguments (11a, 12a, 13a) and adjuncts (11b, 12b, 13b) which have the same form can appear on the same side of the verb in English (Grimshaw 1994):

(11) a. *He put the child **in the pram**.*
b. *The child was eating a biscuit in **the pram***.
(12) a. *He put a book **in his room**.*
b. *He wrote a book **in his room**.* (Grimshaw 1994:417)
(13) a. *The performance lasted **for an hour**.*
b. *The performer wriggled **for an hour***. (Grimshaw 1994:417)

In both the **a** and the **b** sentences of the pairs above the Prepositional Phrases *in the pram, in his room* and *for an hour* appear on the same side of the verb. But in the **a** contexts, it is an obligatory argument, and hence relevant for the meaning of the verb, whereas in the **b** sentences it is an optional argument, which does not contribute to the meaning of the verb. The child can only know which Prepositional Phrase is an argument and which one an adjunct only if he/she knows the meaning of the verb (Grimshaw 1994:417). A possible answer to this criticism could be that the child relies on the examination of all the frames in which the two verbs occur. Recall that syntactic bootstrapping assumes the need of multiple frame analysis, which is defined as an iterative application of the single-frame procedure.

But the relevance of multiple frames has also been questioned. Pinker (1994b) argues that the process of learning the meaning of a word from a single frame is

fundamentally different from the process of learning the content of a verb from a set of syntactic frames. Grimshaw (1994: 419) points out that:

> *...the question is whether UG determines the subcategorization set associated with a verb, or not. This issue turns out to be highly problematic – the reason is that the total subcategorization set of a verb is a function of the set of subcategorizations in which each* ***sense*** *of the verb participates. And the way senses are distributed across morphemes is not uniform across languages.* [..]. *UG says little or nothing about the complete set of senses the verb has, and therefore little or nothing about the total set of subcategorizations of the morpheme. UG only determines the properties of the individual senses and those that are related grammatically*.

Another problem which the syntactic bootstrapping proposal does not seem to be able to solve appropriately according to the advocates of the semantic bootstrapping hypothesis is the one of many-to-one-semantics-to-syntax mappings (Grimshaw 1994, Pinker 1994b). Consider, for example, the set of verbs in the sentences below (all the examples are from Grimshaw 1994:418):

(14) a. *He weighed the tomatoes.*
b. *He weighed 300 pounds.*
(15) a. *He became a doctor.*
b. *He shot a doctor.*
(16) a. *He asked someone the time.*
b. *He asked someone a question*.

The syntactic frame is rather uninformative with respect to verb meaning in all these sentences. It can only provide information with respect to the number of arguments which the verb relates in each context, but it cannot help the child infer the root meaning of the word.

5.3.2 Semantic bootstrapping

Semantic bootstrapping hypothesis: children rely on word meaning to learn word syntax.

A different point of view on how children cope with word meanings is that the young learner can infer the meanings of words from observation of the world, without grammatical evidence. The process of acquisition is assumed to rely on mechanisms which imply non-linguistic cognitive inference. On such a view, syntactic frames can only inform the learner about the meaning of a word in that particular frame, but they cannot possibly lead him/her into correctly inferring the root (or core) meaning of that word. The role of syntactic information is not denied, but it is not seen as crucial. The learning of word meanings implies the existence of contingencies between perceptual and syntactic categories which, mediated by semantic categories, can help the child to acquire the properties of words.

One important claim of the semantic bootstrapping hypothesis is that there exists a close relationship between semantic and syntactic categories, and that the child uses the former to infer the latter:

> *...[t]he claim of the Semantic Bootstrapping Hypothesis is that the child uses the presence of semantic entities such as "thing", "causal agent", "true in past", and "predicate-argument relation" to infer that the input contains tokens of the corresponding syntactic substantive universals such as "noun", "subject",*

"auxiliary", "dominates", and so on. [...] *this knowledge is used by several sets of procedures to build rules for the target language*. (Pinker 1987: 407)

The hypothesised semantics-syntax isomorphy "bootstraps" the child into syntax. Semantics and syntax are related by linking rules (Jackendoff 1987,1990, Pinker 1989), which are universal and innate, and hence do not have to be learned. The child is able to link semantic entities such as Agent, Patient or Theme to grammatical roles such as Subject or Direct Object. Obviously, the implication is that children can analyse which word in the input corresponds to the label Agent, Patient a.s.o. and that the child makes use of linking rules to infer that the Agent should be realised as a DP and appear in subject position.

Let us take an example. On hearing a sentence of the type *John is eating an apple*, which contains a transitive action verb, the child will infer that it denotes an action which involves an Agent and a Patient and, in accord with the available linking rules, the action will correspond to V/VP, the Agent to the Subject DP and the patient to the direct object DP. Used in a semantically transparent situation, the sentence will be analysed as:

(17)

John	is eating	an apple
↓	↓	↓
Agent	action	Patient
↓	↓	↓
DP	V	DP
Subject		Direct Object

Notice that such a view assumes that a mechanism of identification of grammatical functions has to be in place. Also, the child has to be able to identify the situation as a certain event type, i.e. a certain conceptual structure, and then map the word onto the mental representation of that structure. Conceptual structure is given by the child's perceptual and cognitive mechanisms and it is linked to the verb when the child hears that verb used in a situation which exemplifies the pre-existing structure. The child is claimed to map a string of sounds with a mental representation of a concept via the so-called *Event Category Labelling*. When some meaning does not correspond to the pre-existing event types, the child resorts to the mechanism of hypothesis testing. Incorrect hypotheses of word meaning will be eliminated as a result of observing how that word is used across situations. For example, for the verb *fill*, the child represents the Agent-Patient relation, the fact that the Patient is a liquid, the goal of the Agent a.s.o. This set of semantic relations associated with the verb are retained by the child and constantly re-evaluated in accord with the new situations in which the verb is heard. In the end, the child will retain only that subset of semantic relations which are relevant for the core meaning of the verb. On the basis of observation of contexts, he/she will know that *fill,* unlike *load*, does not belong to the locative alternation class in spite of their similar semantic properties. The hypothesis testing procedure is constrained by certain semantic biases, discourse and the mutual exclusivity assumption.

Acquisition of meaning appears to be determined not only by innate conceptual knowledge, but it also requires hypothesis testing and induction.

Evidence that word learning is possible without aid from syntax and that children possess abstract semantic categories as well as mappings between these categories and syntactic categories comes from the area of noun meaning. For example, when English

monolingual children have to learn words of the type *camp, college, church*, which refer to individuated objects, just like countable nouns but which, at the same time, can be used 'bare' in a sentence, unlike countable nouns, they rely on the semantic properties of these nouns (they all refer to cultural institutions that involve habitual events and they belong to a subclass where all members refer to the same kind of institution, Soja 1994) in order to categorise them (Burns and Soja 1995). However, one should point out that when the children in the experiment also received explicit syntactic information that the novel noun was an NP-type noun they were more likely to categorise it as such. 'This suggests that although they can categorize a novel NP-type noun given only the semantic information, they prefer to have supporting syntactic information as well' (Burns and Soja 1995: 30).

Both Japanese and English speaking children extend novel nouns in accord with the shape and the type of material of which the object denoted by the noun is made prior to and independently of the acquisition of the count-mass syntax (Imai and Gentner 1997).

In determining whether a novel term is a proper noun or a common noun, Japanese children have no syntactic clues to rely on: Japanese syntax does not specify whether a noun is a common one or a proper name. But, in spite of the lack of syntactic cues, they manage to infer the meaning of novel terms by resorting to other constraints (Imai and Haryu 1999).

One should notice that, in spite of the fact that the hypothesis does not explicitly state it, it does assume a transparent mapping between language and extra-linguistic events. It has already been shown that observation of extra-linguistic contexts is not always enough, and that it is quite difficult to accept that there is one-to-one mapping between language and situations which language describes (see, for example, Gleitman 1990 or Fisher 1995 among many others). When observing a scene, how does the child know which part in the string of words is the object, or the subject? It seems that:

> *An innate array of concepts is not going to help the child in deciding which concept fits the scene they just witnessed. Since one breaking scene is never identical to another in the natural world, children have an infinite hypothesis space to draw upon in conceptualising the event. Just hearing a word in context does not guarantee that children will fast map the word correctly*. (Clifton et al. 1995: 62)

The linking rules assumed by the hypothesis are not without problems either. Recall that one such rule states that the Agent of a verb projects as the Subject of the sentence. But it is only the subject of transitive verbs that tends to be the Agent. And not even subjects of all the transitive verbs are Agents. The mapping of thematic roles onto grammatical roles may depend on the structure of the whole sentence. The linking rules assumed by the semantic bootstrapping hypothesis cannot really account for how a child represents the relation between the meaning of a verb and clause structure (Fisher 1995).

In spite of its intuitive appeal, the semantic bootstrapping hypothesis is not without problems. One can hardly find positive evidence in favour of the isomorphic relation between syntactic and semantic categories at an early stage. Also, by postulating such an isomorphic relation one has to accept that there is an initial stage in lexical development when child's language differs from that of the adult in an important way.

5.4 A possible reconciliation

5.4.1 The two hypotheses compared

A closer look at the two hypotheses with respect to the acquisition of word meaning will actually reveal that there are assumptions which they share and that they are not as radically different as it might appear at first sight. Let us see first what the two theories have in common. They both assume that:

(i) children are endowed with the innate ability of making certain hypotheses about the meaning and the grammar of words
(ii) children rely on domain-specific learning procedures to examine the incoming stream of words in the linguistic input; the child is able to conduct syntactic analyses of the input
(iii) children also have to rely on domain-general procedures (such as pattern detection or hypothesis testing for example) to correctly analyse the linguistic input
(iv) the input which is relevant for lexical learning is the linguistic input; however, the role of the extra-linguistic context is not denied.
(v) they both assume that semantic information is useful
(vi) syntactic clues are useful. In particular, syntactic information restricts the hypothesis search within the domain of semantic interpretation.
(vii) there are syntax-semantics mappings.

They differ with respect to the importance they assume semantics and syntax play in the process. On semantic bootstrapping assumptions, the child first analyses the extra-linguistic situation. This analysis allows him/her to hypothesise the meaning of a certain word in the stream. And it is the meaning of the word which leads the child into the syntax of that particular word. Semantics bootstraps the child into syntax. On syntactic bootstrapping assumptions, the child analyses the incoming stream of words first, and this analysis allows him/her to infer the meaning of a word. In this case, syntax bootstraps the child into semantics.

Experimental evidence has shown both the relevance of syntactic cues in the process of lexical acquisition and that the acquisition of certain lexical items is possible in the absence of overt syntactic cues. What no experiment has denied is that children are able to exploit syntax-semantics mappings. This suggests that these mappings may be the ones which constrain children's word meanings even prior to the acquisition of syntax. This does not lead us directly to the conclusion that early grammars are semantic. What it suggests, however, is that there may be a stage during which children rely on syntax-semantics mappings. We have seen that during the two-word stage, children often use only or mainly lexical items but the way in which these items are projected suggests that they have knowledge of the thematic properties of these items and that they know how to 'project' them. One can detect certain regularities in the range of semantic relationships expressed at this age. Knowledge of thematic roles may be extremely important:

> *Thematic roles play a central role in language comprehension. We suggest that thematic roles provide a mechanism whereby the parser can make early semantic commitments, yet quickly recover from the inevitable misassignments that occur as a consequence of these early commitments. Further, we suggest that thematic roles provide a mechanism for interaction among the syntactic processor, the discourse model, and real world knowledge, and that thematic roles help create coherence in local structure.* (Carlson and Tanenhaus 1988:263-264)

On the other hand, syntactic cues are extremely reliable. An extra-linguistic situation can be conceived in various ways, but a syntactic cue is clear: if a noun is preceded by a quantifier, it has to be a countable noun, if a verb is used in the progressive, it has to denote an action a.s.o. It has also been shown that observable properties of sentences, such as the number and order of familiar nouns, can be interpreted as analogically representing aspects of their meanings (Fisher 1995) It may be the case that 'the child's sensitivity to linguistic information actually supports a semantic theory; it does not refute it' (Bloom 1994:312). In which case, the hypothesis that syntax-semantics mappings guide word learning gains support.

A reconciliation model: the semantics-to-syntax mappings provide the predictive mechanism; the syntactic frames provide the checking mechanism.

5.4.2 A reconciliation model

Grimshaw (1994) proposes what she calls **a reconciliation model,** within which the semantics-to-syntax mapping principles play the part of a predictive mechanism and the syntactic frames that of a checking mechanism. The acquisition steps assumed by her reconciliation model are the following ones:

(i) *The learner interprets a scene or situation, hears a sentence and detects the verb.*
(ii) *The learner finds a relationship R among participants in the situation (entities, propositions etc.) that is sensible given the interpretation of the observed situation.*
(iii) *The learner checks that R involves participants consistent with the content of the (candidate argument) expressions in the sentence, and rejects an R that does not meet this requirement.*
(iv) *The learner constructs a lexical conceptual structure which is consistent with R, and assigns candidate argument expressions in the sentence to argument positions in the lexical conceptual structure.*
(v) *This lexical conceptual structure is fed through the semantics-to-syntax mapping principles of UG in their language particular instantiation.*
(vi) *The s-structure predicted by step 5 is compared to the observed s-structure.*
(vii) *If they do not match then no learning takes place.*
(viii) *If they do match then the morpheme is entered into the lexicon with the hypothesized lexical conceptual structure.* (Grimshaw 1994: 423).

On such a reconciliation model it is semantics that predicts syntax. Syntax has the role of eliminating the wrong semantic candidates. Semantics leads the child into the semantic content of words. Syntax can only constrain analyses of the semantic structure of a word. For example, it can provide the clue that a certain verb is a change-of-state verb, but it cannot provide information with respect to what kind of change of state it denotes. Syntactic information is also assumed to provide enough structural information to allow the child to infer the meaning of a verb for example, without ever having witnessed a situation that exemplifies the one described by the verb. The implication is that the linguistic input is crucial for the learning of word meanings. Language provides 'information about word meaning which is orders of magnitude more informative than observation of the world can be' and 'by virtue of the grammatical principles that govern it [...] constrains the possible representations of words in ways that learners can exploit in word learning' (Grimshaw 1994:428).

5.4.3 A coalition model

Children use a coalition of cues available in the input, which they attend to differently during the developmental phases.

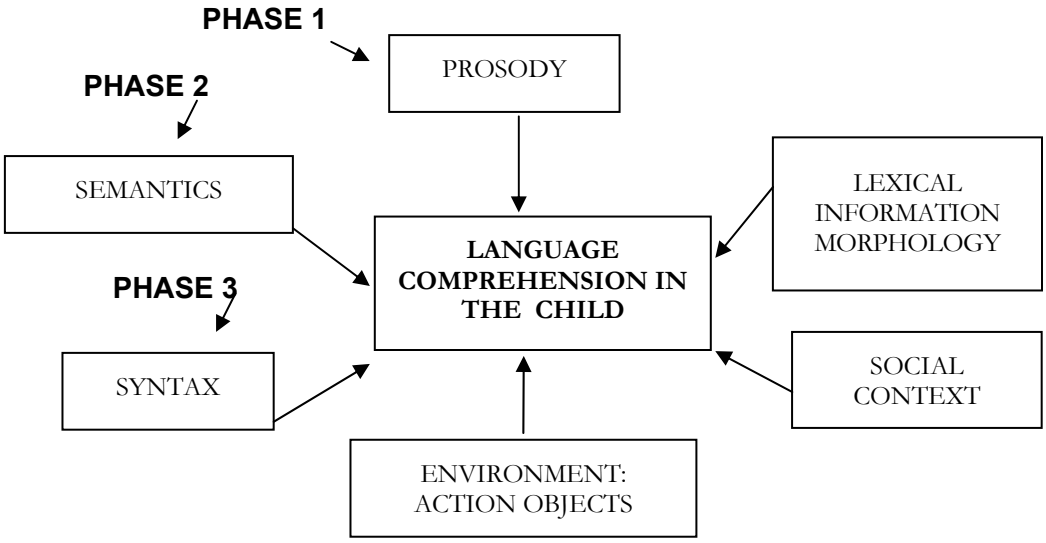
We have seen that the acquisition of word meaning implies the existence of a multitude of cues available in the input, which suggests the possibility of an eclectic approach to language development. Hirsh-Pasek and Michnick Golinkoff (1996) propose such an eclectic model which they call **a coalition model of language comprehension.** They start from comprehension which, according to them, plays a central role in the child's construction of mental models. Also, children are able of more linguistic analysis than they reveal in production. The core assumption is that young children use a coalition of cues available in the input in order to cope with language: prosody, semantics, lexical information morphology, social context, environment, semantics and syntax. Throughout development, children are able to analyse input in multiple ways and they weigh the cues differently so that, at various stages, they rely mainly on one of them.

During the first stage (0–9 months) language is processed mainly acoustically. Acoustic packaging is taken as a precursor to linguistic mapping. Children rely on acoustic units in their attempt at segmenting and fusing non-linguistic events. They link acoustics and events. At this stage the child shows a bias for focusing on prosodic information.

During the next stage (9–24 months) children begin to analyse the acoustic units and to map them onto their representations of objects and events. They begin to understand the relationship between sound and meaning, the meaning of certain words, they gradually assign words to their class. They actually begin to map acoustic units onto linguistic units. At this stage, they show a bias for the semantic system.

The third stage (24-36 months) is the time of complex syntactic analysis. Children become aware of interclausal relationships, they can understand passive sentences and binding relations. They can now rely on syntactic information.

What the coalition model actually proposes is that the cues are available in the input all the time. It is only that the child has a bias for focusing on one particular type of cue during the different phases of linguistic development: prosody during the first stage, semantics during the second and syntax during the third:



6. Overextension of word meaning

6.1 The question

Children frequently overextend familiar labels to inappropriate referents.

Once the child has associated the label with a certain meaning, a new task is awaiting: he/she has to extend the label to other similar objects, actions or properties. How does the child know that the term 'cat', for example, a label for the furry white pet, is an appropriate label for any other cat but not for a dog or a tiger? Although lexical items in early vocabularies are often used with their conventional use, there are also frequent cases of words which are used in a non-adult way, i.e. their meaning is not the conventional one. More often than not, these differences are the result of overextension. Children ascribe a more general meaning to a particular word than adults. The word 'cat' may be extended to other four-legged animals, or the word 'moon' to any other round object. How can one account for the differences between the child and the adult word meaning? What causes overextension of word meaning?

Different answers have been proposed relying, each, on a different theoretical background. In what follows, two possible answers will be briefly presented: the answer provided from the perspective of the semantic feature approach to word meaning and the one relying on the prototype theory.

6.2 A semantic feature account

Children overextend terms because they have abstracted only a subset of the features that define the term.

The componential or feature analysis of word meaning has at its core the idea that there exists a set of semantic primitives which the human mind can use in order to analyse word meaning. For example, the meaning of the word 'cat' can be partially represented by the following features:

(18) cat

$$\left\{\begin{array}{l}+\text{ANIMAL}\\+\text{FELINE}\\-\text{JUVENILE}\end{array}\right\}$$

Clark (1973) relies on such a componential analysis of word meaning in order to provide a possible developmental story according to which early word meaning may be underspecified. On her account, children (aged 1–2; 6 years) would overextend a term when they have abstracted only a subset of the features that make up its definition, i.e. when they have partial knowledge of the meaning of the word being used. Overextension would be, according to Clark's proposal, due to a matter of competence.

6.3 A prototype theory account

Rosch (1973,1975) proposes a different approach to word meaning. On this view:

Children over-extend terms because they pay more atten-tion to different attributes than adults do.

(i) membership in a natural category is determined by a set of features, strongly associated, which can be more or less criterial, i.e. more or less members of the category can display them;
(ii) the member of the category which displays the largest number of criterial features is the prototype of the category;

(iii) gradation of membership is allowed along a continuum: some members are more central, they display more criterial features, other members are marginal, displaying a small number of relevant features.

Within such an approach to word meaning, overextension implies an underlying representation of the prototype and the ability to abstract the core features of this prototypical exemplar. It may be that the child pays more attention to different attributes from adults.

6.4 A performance account

Children never overex-tend in com-prehension.

The two answers briefly sketched above assume that overextension errors are competence errors. If this were the case, one would expect such errors to occur both in comprehension and in performance. However, it has been shown that children may extend in production but they do not do so in comprehension (Fremgen and Fay 1980). An experiment which tested 16 English-speaking children's (aged 1;2-2;2) overextension errors in production and comprehension showed that the same group of children overextended a total of 27 words in production but, on comprehension trials for the words overextended in production, each child indicated the appropriate exemplar.

The results of the experiment suggest that overextensions arise from constraints on linguistic performance. Overextension errors may be caused by difficulty in retrieving the correct word (when the child already knows the word for the inappropriate exemplar) or by 'a lack of vocabulary with the concomitant performance strategy of substituting a word which the child feels is similar enough in meaning to what he wants to express' (Fremgen and Fay 1980:210-211).

SUMMARY

Children acquire words at a tremendous speed in spite of the difficulty of the task. How do they manage to do that, given that relying on mere observation of the extra-linguistic context is not enough? Various hypotheses have been presented:

- they may be limited in their hypotheses by some (innate) constraints
- they may be helped by some constraints which are not language specific
- they may be helped by the linguistic input which they receive
- cognitive abilities, memory, attention span and socialising skills may also help the child in the domain of vocabulary acquisition
- they are able to exploit syntax-semantics mappings or semantics-to-syntax mappings
- they make use of all the cues (prosody, semantics, syntax, extra-linguistic context) available, using them differently at different developmental stages.

Children's early use of certain words may differ from the conventional one. The most frequent type of error is that of overextension. The possible causes of this type of error are:

- a limited vocabulary
- retrieval difficulty
- underspecification of semantic features
- different, non-adult-like importance attached to certain attributes

Acquisition of vocabulary has been shown to be related to both domain-specific and domain-general learning mechanisms.

It has been proposed that the nature of the input plays a more important part in the process of lexical development than it does in the case of syntactic development.

Further reading

General: Bloom (2000) offers a general discussion on the acquisition of word meaning, viewed as a process which implies cognitive abilities used for other purposes. And you can always go back to Pinker (1989, 1994).

Focussed: If you want to find out more about children's creativity in the domain or novel word creation, Clark (1993) is a good choice. It deals with lexical acquisition in a large variety of languages, with a focus on how children use general principles in the analysis and creation of complex word-forms. If you are interested in details of the semantic /syntactic bootstrapping hypotheses, you should then go to Pinker (1989) as well as to the papers mentioned in section 5 of this chapter. Very early lexical acquisition is discussed in Chapters 4 and 5 in Boysson-Bardies (1996, English translation 1999). For insights into the learning of the lexicon in L2 acquisition and a comparison of L1 and L2 acquisition of word meaning, try Juffs (1996).

Textbooks: In Goodluck (1990) you can find a brief presentation of the semantic bootstrapping and the syntactic bootstrapping hypotheses in Chapter 4 – *The Acquisition of Syntax.*