

## Introduction

Learning vocabulary is much simpler than combining words into sentences to communicate - e.g. think about learning a foreign language.

Two approaches to how grammar is acquired by children discussed in this chapter - *nativist* (innate) view vs *empiricist* (environmental factors).

Development of grammar illustrates cognitive development is a journey from piecemeal knowledge to an organised and systematic understanding.

## The nature of spoken language

Spoken language consist of:

Phonology: the structure of speech sounds

Grammar:

Morphology - the structure of words

Syntax - the structure of sentences

Children develop a mostly implicit understanding of these elements.

## Phonology

Knowledge of the sound-patterns of a language. Example: [b] (bat) [p] (pat) different in English, indistinguishable in Arabic. If such subtle cues are missed, misunderstandings occur. Much of the first year of life is spent mastering speech production or understanding the dominant sound patterns of an infant's world.

## Morphology

Knowledge of how new words are created from existing words - e.g. compounding, plurals and past tense. Research (**Pinker**) shows initial production of plurals and past tense is perfect at first, drops off (over-regularisation errors) and then returns to perfection - so called "U-shaped development".

## Book 3 Chapter4 - The Development of Children's Understanding of Grammar

[This pattern of development is also shown by Adam in **Brown's** 1973 study and in a computer model - **Plunkett and Marchman**, 1993.]

## Syntax

Knowledge of the way words are combined to form sentences. Provides information about 'who did what to whom' - e.g. John gave Mary the flowers; Mary gave John the flowers. It is the word order that creates the meaning, not the words themselves.

The rules are complex - e.g. to turn the sentence 'a unicorn is in the garden' into a question you move the first 'is' to the front, but this simple rule doesn't work for 'a unicorn that is eating a flower is in the garden', demonstrating our sensitivity to complex aspects of sentence construction.

## Learning morpho-syntax

Languages vary as to how much morphology or syntax is used to signal who did what to whom. The question is how do children acquire this capability?

1st suggestion (Empiricist) - children have to work out the significance of morphology & syntax based on experience:

e.g. Mary chases John / John chases Mary => syntax cues

Mary-da chases John / Mary chases John-da => morphology cues

2nd suggestion (Nativist) is that they already "know" languages can be syntactically or morphologically oriented - born with an implicit understanding. **Chomsky** (universal grammar concept). Necessary because children aren't presented with coherent examples from which to 'learn' - how do they know what is important to focus on?

## The development of spoken language

### One word at a time

Children produce first words sometime after 12m.o. They are simple (mama, daddy, cup, drink, no, more) and relate to their environment. Single word conversations have surprising utility, when connected with gestures, intonation, facial expressions, gaze direction etc.

### Early combinations

A vocabulary spurt happens at around 21m.o. Shortly before this, word combinations start to appear (look ... doggy) - telegraphic speech. Common phrases used by adults are copied by children - e.g. What's that? Often produced inarticulately, as if they are chunks of speech that have simply been memorised - known as formulaic speech or amalgams.

After the vocabulary spurt, telegraphic speech is more fluent and formulaic speech starts to decline.

### Utterance length as a measure of complexity

Mean Length of Utterance (MLU) - standard way of measuring grammatical complexity, introduced by **Brown**. Study of three children (Adam, Eve, Sarah) just starting to produce >1 word utterances at the start of the study (different ages). MLU calculated by taking first 100 utterances from a transcription and finding the average length in morphemes (units of meaning). **Brown's** stages:

Stage	MLU	Forms
I	1.75	Telegraphic speech
II	2.25	-ing, plurals, in and on
III	2.75	Some specific uses of the verb 'to be', definite and indefinite articles, irregular past tenses, -'s to indicate ownership
IV	3.5	Regular past tense of verbs (add /ed/), use of third person
V	4.0	Use of auxiliary verbs

Note: Individual variations in patterns of linguistic development means MLU should not be used as an unambiguous indication of the emergence of forms as implied by the stages.

Everything so far in this section is based on studying the use of expressive language, measured through the use of systematic transcription - based on either *phonetic* or *orthographic* transcriptions (orthographic transcriptions are usually the favoured method). Systematic transcription doesn't provide much insight into what children know about a language - they say less than they know.

Experimental methods have to be used to determine this aspect - known as receptive language.

One such method is the inter-modal preferential looking task - **Spelke**. She demonstrated that if you coupled a sound with two visuals - one that related to the sound and the other not relating - *children spend more time looking at the event that is consistent with the sound heard*.

This technique was used by **Naigles** to investigate if 2y.o. children were able to use the grammatical context of a sentence to work out the meaning of a new word.

Children shown two scenes - one causative (duck making a rabbit bend over), one non-causative (both animals waving). Children exposed to a nonsense verb - 'gorp'.

One sentence is transitive 'the duck is gorging the bunny'; one intransitive 'the duck and the bunny are gorging'.

The scenes were then shown separately. Children looked at the causative action longer than the non-causative action if they heard the phrase 'the duck is gorging the bunny'. They look at the non-causative action longer if they hear the phrase 'the duck and the bunny are gorging'. Provides evidence children use sensitivity to grammar to learn about verb meanings.

### Full blown grammar

The transition is rapid - by 4y.o. most children are very competent. They can ask questions, make statements and issue commands. (**Brown**, longitudinal study of Adam provides evidence).

Between 2;3 and 3;2 length of Adam's utterances increased, not always grammatical. By 3;2 utterances are more in line with adult speech - 'I want to have some espresso'. Main source of error is omission of words. Inserting the missing words makes his sentences grammatical - showing a grasp of syntax.

Children also correct others speech - even if they get it wrong to start with (e.g. readed and read).

**Brown and Hanlon** argue they assimilate the main structures of their native language without explicit instruction or correction. So, is language acquisition driven by innate cognitive mechanisms, such as universal grammar, or by experience of their environment?

### Learning about word endings

Development of plurals and past tense shows surprisingly few errors - U shaped development seen. The traditional explanation for this is that children initially memorise (so don't make mistakes); then discover the underlying rules - /s/, /ed/ - experiment and make mistakes because they over-regularise; and finally as they become more experienced are then reliably able to use regular and irregular forms.

Disagreement as to how this occurs - dual route theory (**Pinker and Prince**) and single route theory (**Rumelhart and McClelland**) are two competing explanations.

### Dual route theory

Two cognitive systems operate in parallel.  
i) A rule system adding the ending to the stem;  
ii) A memory system containing a record of irregular words and most common endings

When a word needs to be inflected, the memory system is consulted first to see if an irregular form is stored. If so, it is produced, if not, the rule is activated.

The memory system is therefore critical to correct production. If an irregular form is not retrieved, it leads to the over-regularisation rule. The theory suggests that the most common inflection becomes the default rule - e.g. /ed/ for the English past tense (**Marcus et al**).

### Single route theory

A single cognitive system is used to store all inflections. **Rumelhart and McClelland** used a simple connectionist model to show that this would be possible. **Plunkett and Juola** trained such a network on 5,000 different English inflections - the network showed the typical U shaped development pattern seen in children.

### Comparing Dual and Single route theories

SR theory differs from DR theory in its explanation of the cause of over-regularisation - here, it is interference effects between words; in the case of dual route theory it is because of competition for resources between two different cognitive systems.

Both theories explain the eventual disappearance of these errors as a by-product of strengthening of the memory traces of irregular inflections.

The two theories also account differently for what happens when a new word is encountered. The word 'wug' would be inflected as 'wugs'. DR theory explains this as their being no entry in memory to block the

application of the 'regular plural' rule; whereas SR theory explains it as being similar to other words - e.g. mug, slug, bug.

Experimental evidence generated by Marchman favours the SR theory where a vocabulary is very small.

#### Cross-linguistic evidence for SR theory

English nouns/verbs mostly have regular endings and take a single inflection. DR theory would therefore give an efficient system - few exceptions to store in memory.

German is different - e.g. plurals have 8 different regular endings. **Marcus et al** argued that the most common ending '-s' becomes the default rule with all other endings having to be stored (the most common ending is actually not '-s'). If this is true, then most over-regularisation errors should be of the '-s' type.

**Szagun's** later study provided evidence that this did not happen - over regularisation errors being consistent with the inflection's in parent's speech. He argues that SR theory is therefore the best explanation for languages like German - i.e. by generalising from the different regularities than learning endings by rote as suggested by DR theory.

#### Developmental disorder evidence for DR theory

Typical development in English and other languages therefore seems to favour SR. Pinker argues that the breakdown of usage in inflections favours DR - citing Williams Syndrome and Specific Language Impairment (SLI) as evidence.

Studies of children with WS (e.g. **Bellugi et al**) show an ability to produce regular past tense but struggle with irregular verbs; in the case of SLI (e.g. **Gopnik and Crago**) the reverse is true.

Pattern of results reflects a double dissociation between regular and irregular verbs - suggesting two cognitive processes are at work.

However:

i) Other studies (**Thomas et al** and **Bishop et al**) have not found similar results for WS and SLI respectively

ii) SR theories can also replicate double dissociations - e.g. **Joanisse and Seidenberg, Juola and Plunkett** have done so using connectionist models.

Note that SR has a lot of other good things going for it:

- i) It is a simple account (obeys Occam's razor)
- ii) It is biologically plausible - neural connections work in this way
- iii) It argues for distributed representation of knowledge in the brain that is resistant to minor damage

#### *Learning about word order*

The two competing explanations of how inflectional morphology is acquired have been traditionally associated with nativist (DR) or empiricist (SR) positions (though a DR theory can be presented that arises through learning).

The acquisition of syntax - word order - is another nativist-empiricist discussion.

Telegraphic speech, while close to normal English syntax in many ways still requires much linguistic work before it is. Wh- questions like:

What Daddy is eating? and: Where Mummy is going?

have the auxiliary verb (is) in the wrong place. However, without the Wh- words they are legitimate sentences. Children therefore have to acquire the skill to perform subject-auxiliary inversion to form questions correctly.

#### What, where, why, who - asking q's about syntax

The idea that a limited set of possibilities follow a wh-word is not true: consider:

What colour is the grass?  
What type of plane flies to NY in less than 4 hours?  
What Stephen did is of no consequence

The range of possible 'what' sentences is endless - leading Chomsky to propose a nativist explanation arguing speakers can produce this indefinite number of sentences as they have mastered a set of grammatical rules. He also argues that these rules cannot be extracted from the environment - language is too complex. The language learner needs an innate knowledge of the rules of language - Universal Grammar.

#### Grammatical conundrum - nativist solution

Some verbs allow dative alternations (e.g. tell), others, that are similar in meaning (e.g. report) do not:

e.g. The man told the story to the boy  
The man told the boy the story

vs: The man reported the accident to the police  
The man reported the police the accident

Children have to tune their grammar to these exceptions. **Pinker** found they make over-generalisations of this type, but it is much less likely they will hear the incorrect form and so correct it - they will only hear the correct forms (unlike verb or plural endings).

**Brown and Hanlon** argued parents do not correct grammatical errors of children systematically - so any theory of language must be able to account for acquisition without the learner being provided with negative evidence. **Demetras et al** argued against this saying indirect/implicit feedback does occur - e.g. through clarification q's or repetitions.

**Marcus** counters arguing that such indirect evidence is unlikely to be of much use as it is still not systematic.

Correction has two possibilities:

- i) The learner 'knows' what verbs allow dative alternation
- ii) The learner only uses dative alternation on verbs they have definite evidence for working in this way.

but children do still make over-generalisations and they do correct themselves!

**Pinker** argues that this is because they know the rules linking the meaning of the verb to the grammar associated with it. Arguing for an innate UG, Pinker explains the errors by arguing it is imprecise knowledge of word meanings that causes the error.

They therefore have the grammar correct - it is just the word meaning they have got wrong. An approach entirely compatible with an innate UG.

Empiricist approach to syntax acquisition

**Tomasello** suggests children acquire knowledge of language structure piecemeal, based on regularities in the way words are used - the distributional approach to syntax development.

Verbs play an important role in structuring syntactic development as they constrain utterances. E.g. transitive verbs demand an object, intransitive verbs do not. Verb meaning provide clues to what sentence structures are permitted. As early knowledge of grammar is piecemeal, children either don't have categories for 'noun', 'verb' etc (a fundamental concept in UG) or the categories are emergent properties of the learning process - not pre-requisites for it.

Children use some of the utterances they hear as prototypes for new ones - **Braine** - diary study - sort of suggests this is happening.

Examination of his son's early words found an ordering pattern. Some words only occurred in one place - pivot words; others were more flexible - open words. Nouns move around a lot - verbs tend to stay put. Argument is that the child notices this and so imitates these patterns in their own sentences.

**Tomasello** argues that such creativity happens in pockets of knowledge at first and as they broaden, they influence each other and lead to systematic grammatical rules. His approach therefore does not require a UG to exist.

As the pockets become more integrated, over-generalisation errors reduce.

**Elman** has shown how a NN can be trained to predict the next word in a sentence from the information available in the sentence structure - but this has a limitation in that they can only do it on sentences to which they have been previously exposed. He also found the sequence in which sentences were learnt had a big impact on the success of the NN. The concept of 'motherese' being spoken (**Snow, Furrow et al**) as a way of allowing children to develop grammatically has been suggested as the human equivalent of this NN training process.

### **Conclusions**

UG and DR theory suggest innate capabilities (**Chomsky, Pinker**).

SR theories and distributional accounts of syntax suggest empiricist explanations.

Balance of evidence favours empiricist accounts:

SR - more credible explanation across different languages, distributional accounts have evidence from NN modelling studies. Consistent with observational accounts of children's learning.

However, it is not the case that there may not be any innate abilities w.r.t. language. Broad theoretical

Agreement exists that humans have specialised machinery that permits language acquisition.

More recent discussions are concerned with understanding the skills that a child brings to learning languages and if they are related to a specific language or are a more general cognitive ability.

Both UG and grammar extraction from the environment are still being considered as possibilities.

Methods are improving and changing constantly - e.g. from diary studies to experimental studies to connectionist modelling.

The real question is how much of language acquisition is innate, and how much is due to environmental factors.

Tim Holyoake 2009, <http://www.tenpencepiece.net/>