

# How children develop their ability to combine words: a network-based approach

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## 1. On hubs

Degree –number of connections/edges– of the first 10-15 nodes within the largest connected component (LCC) in Dutch and Catalan (typical developed children). As the child grows, the connectivity of functional words (bold) increases. It has been reflected the total number of nodes within the LCC as “N”, while *Degree* means the number of edges a word has. Some words still are not well formed in the first stages and the transcription has tried to reflect its pronunciation. Age is represented in days.

Most words tend to have 2-3 connections/edges. Hubs usually tend to have more connections. In the first stages, syntactic networks have few words and most of them have between 0 –i.e., uttered, though not syntactically connected– and 1-2 edges. The term hub is not constrained to a concrete number of edges, since this also depends on the network. If a word has 4-5 edges in the first networks, which are small in size, one could consider it a hub. However, a word with 4 edges within a network of hundreds of words, in which other hubs have 30 or more edges, could not be considered a relevant node.

As it can be seen, other nouns and verbs compete with functional words (determiners, pronouns, etc.) especially in the first stages. However, as the child grows and the conversation changes the topic, nouns and verbs (open class) may vary, while functional words (closed class) appear once and again.

Daan (Duchth)	722 days		736 days		754 days		754 days		761 days	
	N=2	Degree	N=15	Degree	N=29	Degree	N=31	Degree	N=65	Degree
1	buite	1	<b>de</b>	5	is	7	boek	6	<b>n</b>	13
2	<b>dit</b>	1	kikke	4	<b>moet</b>	6	zie	4	bal	9
3			poes	3	hier	6	<b>een</b>	4	ook	7
4			dop	3	Pino	3	molen	4	nog	6
5			ka	2	kijk	3	je	3	mooie	5
6			jegoes	2	ook	2	kun	3	<b>dit</b>	5
7			oto	2	<b>ie</b>	2	<b>de</b>	3	is	4
8			gejn	2	zo	2	<b>op</b>	3	<b>deze</b>	4
9			<b>in</b>	1	Paulien	2	oor	2	<b>de</b>	4

SUPPLEMENTARY MATERIAL

10			han	1	zit	2	zak	2	grote	3
	783 days		795 days		809 days		827 days		854 days	
	<b>N=82</b>	<b>Degree</b>	<b>N=138</b>	<b>Degree</b>	<b>N=109</b>	<b>Degree</b>	<b>N=107</b>	<b>Degree</b>	<b>N=134</b>	<b>Degree</b>
1	<b>die</b>	14	<b>deze</b>	23	hier	15	<b>deze</b>	25	<b>deze</b>	31
2	kijk	13	<b>op</b>	14	kan	13	is	16	nog	23
3	hier	12	<b>moet</b>	12	<b>deze</b>	11	se	10	hier	22
4	bal	10	boekje	12	kijk	9	hier	9	<b>een</b>	19
5	boekje	8	hier	11	teke	8	<b>dis</b>	8	is	15
6	grote	7	nog	10	seeuw	7	niet	8	<b>moet</b>	14
7	<b>deze</b>	6	<b>eentje</b>	9	<b>die</b>	7	zo	8	zo	13
8	zie	6	mooie	8	eh	7	nog	6	kan	13
9	se	6	motor	8	potood	6	ook	5	zie	10
10	mama	5	kijk	7	nie	6	maken	5	trein	9
11	panien	4	zie	7	mama	5	<b>die</b>	5	dak	9
12	kimme	4	is	6	flesje	5	kan	5	<b>de</b>	9
13	appel	4	<b>een</b>	6	i	4	kei	4	wil	8
14	lezen	4	ook	5	nog	4	Sikkekaas	4	<b>ie</b>	8
15	<b>de</b>	4	<b>de</b>	5	niet	4	oppakken	4	zitte	7
	868 days		882 days		895 days		909 days		926 days	
	<b>N=120</b>	<b>Degree</b>	<b>N=135</b>	<b>Degree</b>	<b>N=145</b>	<b>Degree</b>	<b>N=299</b>	<b>Degree</b>	<b>N=223</b>	<b>Degree</b>
1	<b>deze</b>	19	maken	17	<b>moet</b>	23	<b>moet</b>	42	<b>moet</b>	44
2	is	14	<b>deze</b>	16	<b>deze</b>	23	bij	34	zo	28
3	<b>die</b>	12	wil	15	kan	23	<b>de</b>	33	niet	18
4	nog	11	<b>die</b>	15	<b>op</b>	19	<b>voor</b>	30	is	17
5	hier	10	kan	13	is	18	mooie	26	<b>deze</b>	17
6	<b>de</b>	10	nog	11	hier	17	ook	21	kan	16
7	papa	9	hier	11	huisje	13	<b>deze</b>	21	<b>die</b>	15
8	walvis	9	is	11	nog	12	<b>n</b>	21	heb	15
9	<b>een</b>	8	<b>de</b>	11	<b>die</b>	12	kan	21	<b>ik</b>	15
10	<b>moet</b>	7	huisje	10	ook	11	<b>die</b>	19	kijk	14
11	ook	6	<b>in</b>	10	<b>in</b>	11	moe	19	ga	14
12	mannetje	6	<b>n</b>	10	<b>de</b>	11	is	19	ook	13
13	<b>in</b>	6	ik	10	auto	10	hier	16	<b>n</b>	13

# SUPPLEMENTARY MATERIAL

14	kan	6	niet	9	<b>n</b>	10	nog	16	komt	11
15	<b>n</b>	5	<b>een</b>	8	wil	9	<b>jij</b>	15	<b>je</b>	10

## 2. On the ontogeny of determiners

When a language has determiners, these belong to the closed word class. Some determiners reflect some features, depending on the language. English has *the*, while Catalan, to express the same, has several forms. Children acquire the different forms through time. In many cases it has been seen that there appears a proto-determiner under the form of a vowel –in English it tends to be a schwa– that will be substituted by the canonical form. Here you are an example of the progress of the connectivity of the determiner in Catalan. In order to compare the ontogeny of the Catalan determiner it is important to take into account that English has one form (*the*) but Catalan has several forms in order to gender (masculine, feminine) and number (singular, plural).

CATALAN	Evolution of the determiner (number of edges)						
AGE DAYS	<i>a</i> proto-determiner	<i>el</i> Masculine singular	<i>la</i> Feminine singular	<i>L'</i> Singular article in front of word beginning with vowel	<i>Els</i> Masculine Plural	<i>Les</i> Feminine Plural	TOTAL All forms
593	1						1
613							0
634		1					1
640							0
678	1		3				4
712		3	3				6
785		2					2
799		8	4	2			14
879		9	13				22
938		5	13		4		22
976		19	30	16	9	6	83
1022		17	31	11	1	1	62

